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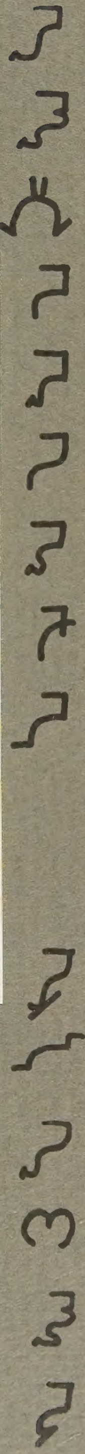

SCARLET	1194
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The Contractors of Chartres

Published by
Mandorla Publications
P.O. Box 214, Wyong, 2259 N.S.W., AUSTRALIA
and
Croom Helm Limited
2-10 St John's Rd, London SW11, ENGLAND

Chapters I–V were first published in French 1977,
chapters VI–XII in 1979, and
chapters XIII–XXII in 1981
by the
Societe d'archeologique d'Eure-et-Loir
16 rue St-Pierre, 28000 Chartres, FRANCE

Chapters I-V were first published in English 1978
in a limited edition of 200, with
text, drawings but without photographs by
Mandorla Publications of Dooralong, Australia.
These first five chapters are included in
this edition as well as the photographs.

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All photographs by author except PHOTOS:44 & 288
by Houvet. The drawings on pages 5 and 52 by
Durand and Page 32 of the south transept in the
collection of M. Couturier.

Made and printed in Australia by
Lakes Printers, Wyong, 2259, N.S.W.
Set in English Times, 10 point text and 8 point notes.

James, John Roger Haughton, 1931-
(Chartres - les constructeurs. English)
The contractors of Chartres. Vol. II
Includes index.
ISBN 0 9596005 4 x (Mandorla Publications)
0 7099 1405 9 (Croom Helm Limited)
1. Cathedrale de Chartres. I. Title.
690'.66'0944'51

THE CONTRACTORS OF CHARTRES

VOLUME TWO

JOHN JAMES

WYONG, 1981

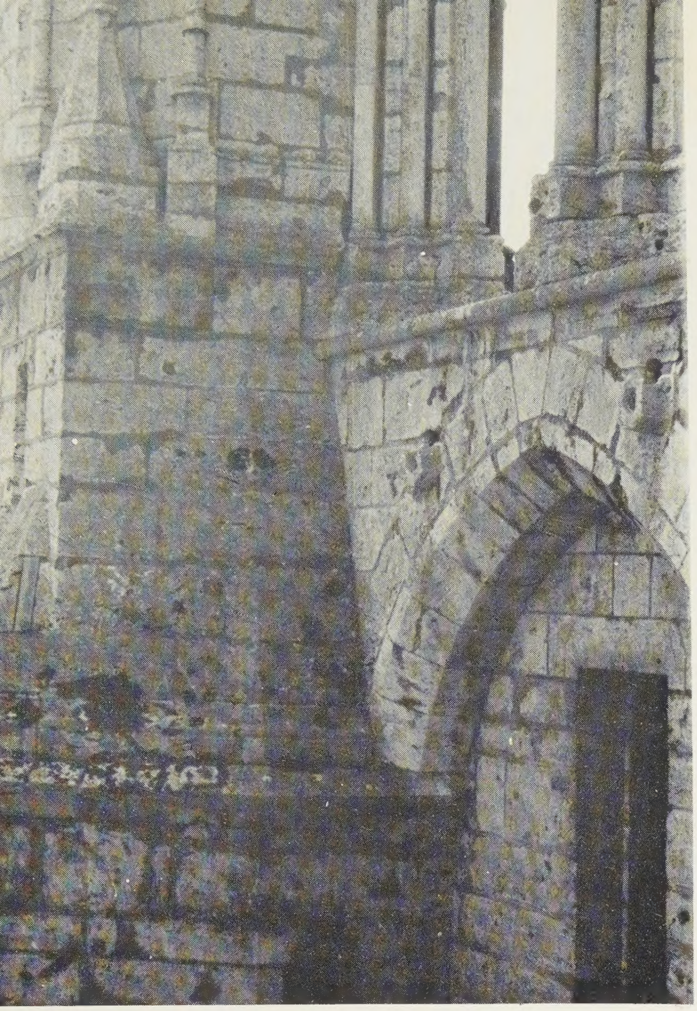
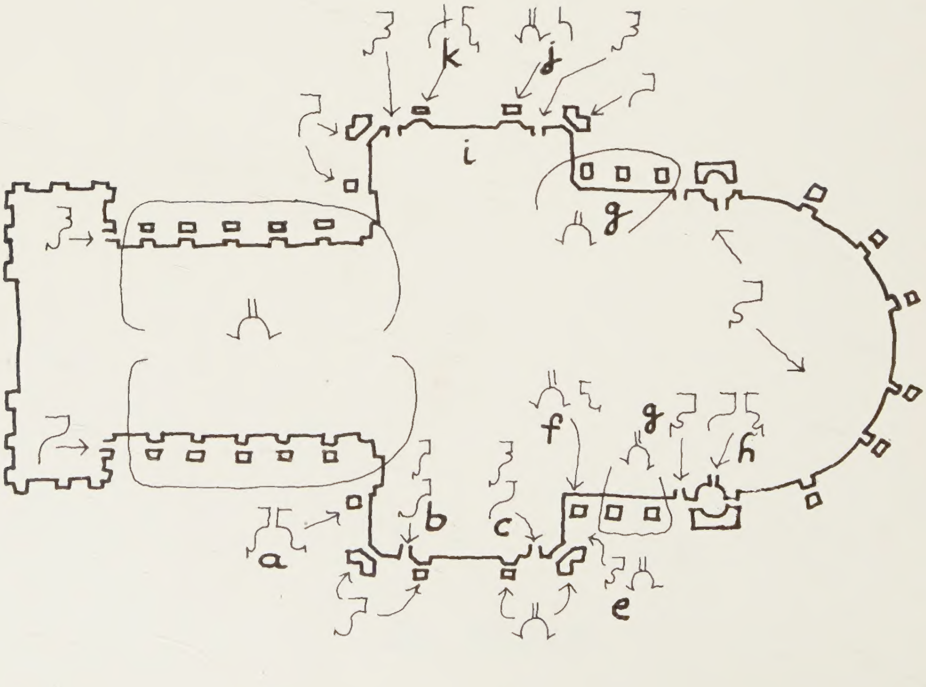


PHOTO: 296 The enclosure around the ES staircase was reduced in size, and then transformed from a square to an octagon. As seen from the roof over the triforium its battered walls, pinnacles and cornices illustrate the sculptured and moulded nature of their architecture.

726.6
J27c
v.2



THIRTEEN

The tower rooms in the south and east.

> *Thought is crude, matter unimaginatively subtle. Words are few and can only be arranged in certain conventional fixed ways; the counterpoint of fixed events is infinitely wide and their succession indefinitely long. That the putrified language of science, or even the richer purified language of literature should ever be adequate to the givenness of the world and our experience, is in the very nature of things impossible.*
>
> Aldous Huxley

I have found that the transepts are the most interesting parts of the buildings I visited, for the differences between the choir, the nave and the transepts themselves must be resolved here. This is why they appear confused, and why most historians have glided past them and ignored the problems they pose. In Chartres, no less than Reims, Soisson or Paris, the transepts are unbelievably complex, and infinitely difficult to describe. A detailed recital of the frustrating path I took to understand it would, as Gibbon remarked, only serve to oppress the memory and perplex the attention of the reader.

Yet we cannot avoid some contact with them if we are to understand the more important work soon to be met in the clerestory. Without the information garnered from the triforium zone of the transepts I would have been unable to disentangle the history of the flyers, and as it will take many pages to assemble all the necessary data I can only beg your patience until it is done.

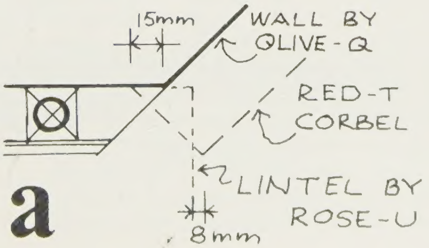
The rooms under the towers at the extremities of the transepts grew slowly. Between Olive-Q in 1210 and Rose-e fourteen years later the masonry under the towers had been raised only 6½ metres: yet at the same time these masters had added almost double this amount to the clerestory. With so many contractors crammed into a few courses the number and arrangement of the construction joints is so complex that we must abandon the staircases: they give too much information. This is one of the few parts of the building where they will be of little use.

Let us move out of the stairs and onto the walkway which encircles the cathedral.[1] On the west it passes through the massive buttresses of the nave under corbels which belong to Rose.[2] It then continues down the western arm of the transept under those of Scarlet. The eastern side of the transept changes back to Rose with Cobalt over the adjoining door into the tower room. But continue through the passage towards the sanctuary and we find Ruby and Rose mixed together, with more of Rose's down the side of the choir, and over the doors into the eastern stairs there are Cobalt's and Red's, while the latter continues around the apse. And if we include the north side, all nine of the masters who worked on the main fabric of the cathedral have unmistakably signed themselves along the one level in a total of ninety six

---

[1] Every master who ever worked on the job before 1235 left a corbel around the triforium walkway and over the various rooms which open off it. Also see n.37 for those around the choir and II:21 for those inside the roof spaces.

a. Rose-U and Scarlet-V alongside one another in the same opening - illustrated in n.22.
b. SW.III-S door, Scarlet-V over the door and Ruby-W capping its lobby. One join can be seen where to the east of the door the small reveal on the buttress was straightened out, above the lintel.
c. SE.III-S door, Cobalt-S ditto and Bronze-X above - n.3.
d. There are no corbels over the two internal doors from the south rooms into the roof space. The lintel over the SE.III-N is by Olive, and the SW by Ruby? They are 2,000 and 1,850mm high. Olive's sanctuary doors in GEOM:XII-C are 2,030 and 1,950mm high - no consistency.
e. The outer corbel with the long plumb-cut is obviously Rose-U, for the corbel is exactly the same as his in the apse (a) — IX:28. The inside one is ambiguous: it is 314mm high compared to Rose's 359mm, and from the coursing could be Red-T. Uncertain. However there is a packer underneath the corbel, and to highlight the change in crews to Rose's bigger corbel opposite, it has a larger joint of 32mm over it. It is shaped for a splayed inside corner, not for the square corner as built in **a**. Compare this with the corresponding corner on the SW side: Scarlet's corbel was cut for a square corner over it, but the lintel was afterwards set 12mm in.



f. All by Rose-U with a 'tumour' - n.16 - except for the east leg where a smaller stone was cut with Ruby's sharper section. This is why in n.18 I gave it to him. This attribution suits all the broken coursing overhead on the south side.
g. Rose-U corbels, not Ruby. See elevation in n.43 and XII:42 and reasons in n.34.
h. ES-N door, Cobalt-S on the west, and Ruby-T on the east - n.43/o.
i. Around the northern rooms - XVII:14.
j. NE outside buttress passage Olive-d and Rose-e - XVII:13.
k. NW ditto: Rose-e and Jade-g.

[2] The geometry of these corbels is discussed in X:15.

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corbels; and this excludes any inside the rooms or roof spaces.

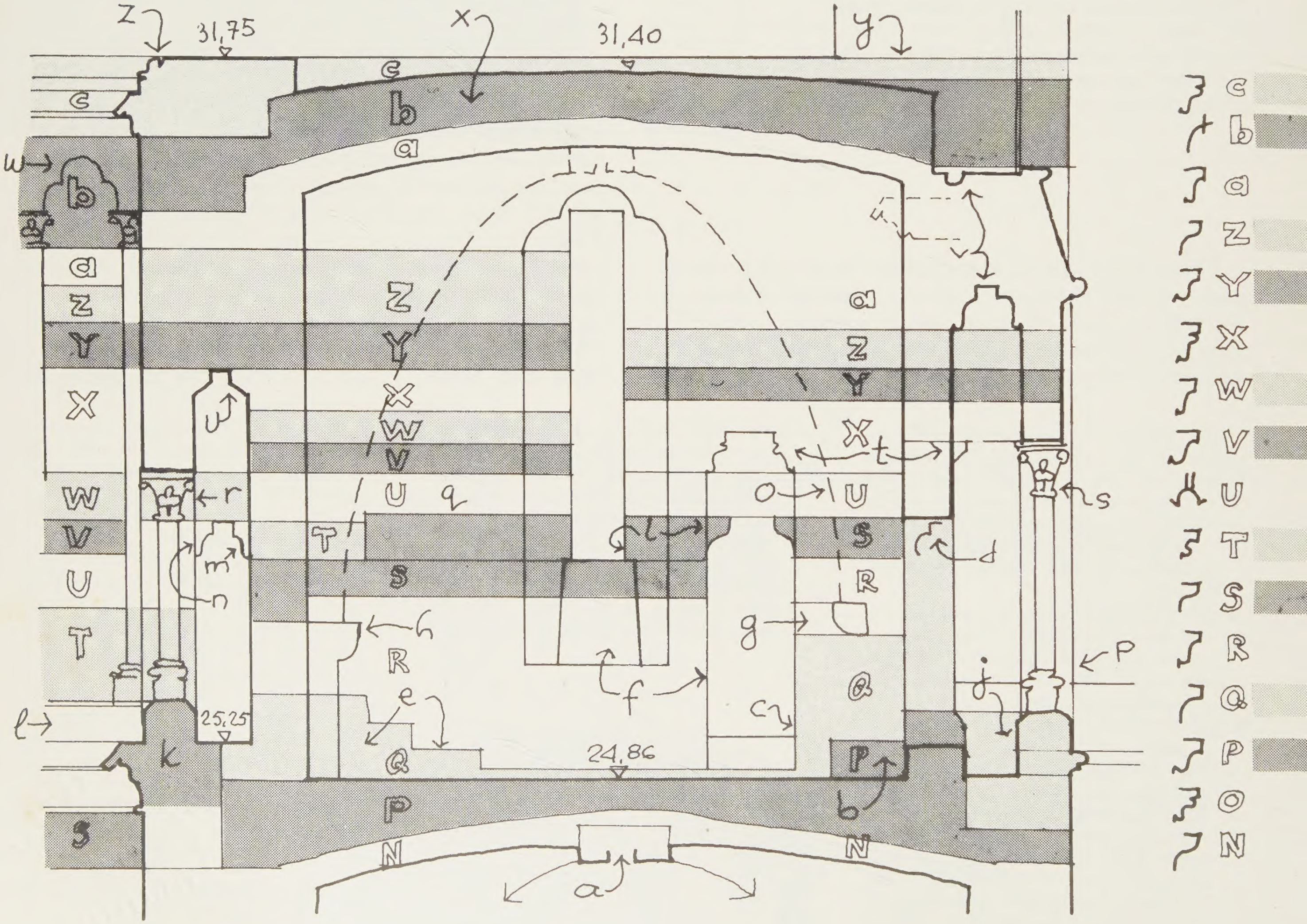
On the inside we can distinguish four contractors from their corbels, and three more in the next level of the towers. The possible arrangement is 'infinitely wide' and an adequate explanation 'is in the very nature of things, impossible'. I can only try with the aid of these drawings and the footnotes which describe them: but in the end you will have to examine the area yourself.

Examine the section through the SE room where I have marked the work of each master.[3] Olive's corbel lies over the door into the triforium passage, cosily enclosed in the usual mason's marks, long stones and pebble-filled joints. He began a little above the floor, and finished in the door lintel. From the position of his joint with Scarlet it is obvious that the latter set out the walls to the northern end of the room. Scarlet's stonework disappears below the level of the floor just before it reaches the southern wall. In the corner his last stone is buried behind a mass of mortar which hides a change in direction.[4]

Therefore the stair buttress outside the room with its splayed sides belongs to Olive. The scheme for the thin colonettes which screen the southern facade may be implied in his work, but was actually begun by his successor. It was a decision of the utmost importance, for it transformed the upper half of the transept into a filigree web of thin verticals, in marked contrast to the plain walls around the aisles. Most historians consider that the design for this facade came later than the rest of the triforium because it looks more vertical and is 'therefore' more Gothic. Frankl considered that a later architect who he called 'C' started this facade after all the flyers to the nave had been finished, and even after the completion of the north front.[5]

However, the cumulative evidence shows that the southern facade was designed first, just as the south porch was finished before the north. If we can talk of an original plan for the cathedral at this level, then the southern front must be closer to it than any other part. It was started by Ruby in 1211, while the heavier design in the choir was not begun until 1216.[6] Facts are facts, and as the illustrious Holmes remarked to Watson, when you have eliminated the impossible, whatever remains, however improbable, must be the truth. The surprising thing is not that the south front is so different, but that the other parts of the building show no reflection of this decision.

The masters who worked around this buttress are



3. *Section through the SE tower room, facing south*
Parts are allocated to the masters by identifiable details, breaks in coursing, etc. Though most of the attributions of the plain walling in between these details follow logically, some uncertain ones have been included to maintain the clarity of the drawing.

COBALT-N, 1207
a. Vault to the aisle under the room -XI:34. The cells may be Bronze.

SCARLET-P, 1209
b. Begins rooms, with door into passage - GEOM:XII-C. Continues wall to the corner - n.4.

OLIVE-Q, 1210
c. Wall to west of south door, with start of outside buttress - n.7.
d. Corbels over the passage door. The joint steps down into the south corner.
e. SE corner of the room with angled pilaster. The joint steps down on the south.

RUBY-R, 1211
f. Finishes south door and begins window - n.15 and text.
g. Corbels for the vault and begins the ribs - n.12.
h. Similar corbel and rib on se. corner.

COBALT-S, 1212
i. Plan for window opening with his corbels over adjoining door - n.15. Joint over this because the jambs were altered to be square to the wall.
j. Inside triforium passage plinths, after the lintel over the gallery door - n.7 and XII:10.
k. Ditto outside and part of cornice - XII:6 and 10/f.

RED-T, 1213
l. Cornice and plinth to buttress, starts wall - XII:6.
m. Inside corbel in sw. corner - n.1/e.

ROSE-U, 1214
n. Corbel opposite 'm', and both at SE.I with tumour. He did not finish the se. leg - n.1/f. The bases under the colonnettes all round the SE.III have his cut corners, except in the se. corner. For the columns in this arcade see n.18.
o. Corbels outside over walkway passage show that this is his door lintel with the next course to the window - n.7
p. Base under southern triforium column after the wall around the stairs - n.7/h.

SCARLET-V, 1215
q. Perhaps one course, no more.

RUBY-W, 1216
r. Last corbel in SE.I, and probably over SE buttress too - n.1. This is also his capital - n.18
s. Triforium column probably set up - n.56.

BRONZE-X, 1217
t. Corbels over two doors - n.1, the bridge over triforium passage - n.56, and the arches over the inside arcade.
u. Uses angled corbels over the external passage as in north 'arcades' - XVII:27/k.

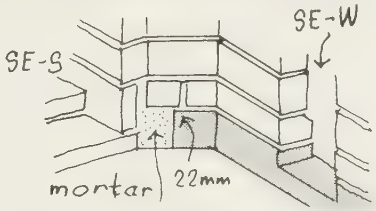
RUBY-a, 1221
v. Corbels over the top of the triforium passage - n.56, and the gutter over against glass - n.54. Hence he must have done the lintel over the window - n.15, and the vault cells following Cobalt-Z's completion of the ribs and base - n.53. Same scheme used in NW-W window - XVII:14/v. Divide courses under this arbitrarily between 'Y' and 'Z'.

JADE-b, 1222
w. The arches over the buttress colonnettes, and hence he did adjoining wall - n.62.
x. Roof over the room - XIV:26, and the upstand on the inside. The gutter to the SW - n.54.

BRONZE-c, 1223
y. Begins SE(cw) door - XIV:27.
z. Cornice around the tower - XIV:26.

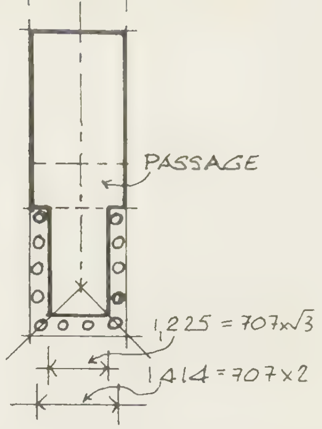
There are fourteen crews from the setting out of the room to the clerestory level. The clues are all there to distinguish them, but you have to look!

4. Marked 'b' in n.3, and shown here in isometric. The shaded stones are by Scarlet-P, including the course below the plinth and western door. Olive's work altered the angle of the splay corner by 22mm part of the way across. The gap between the two team's work is just filled in with mortar. See GEOM:XIII-A.

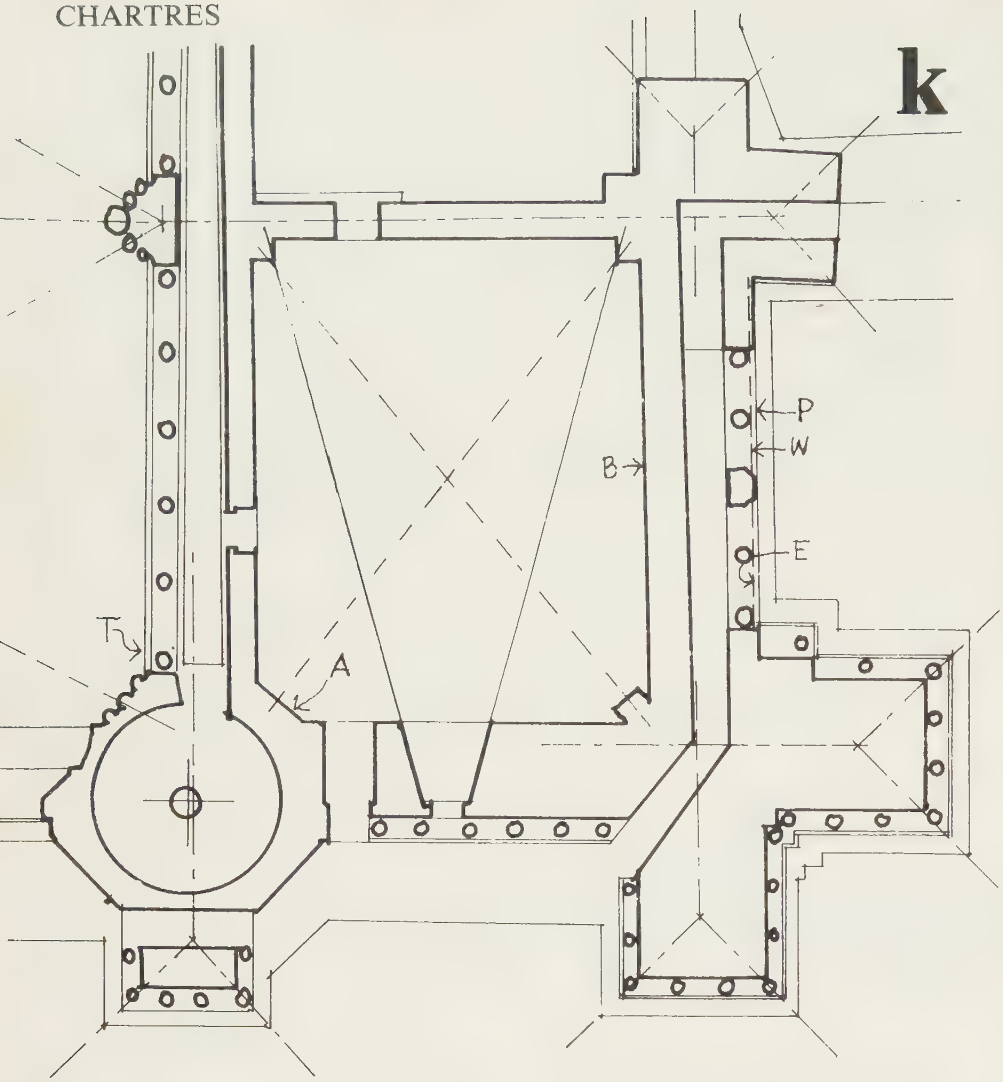


5. Frankl, 1957. None of those who have followed this reasoning have resolved the contradiction that the south rose, which they agree is older than the north, lies embedded within the 'later' facade.

6. The coursing of stones within the roof shows quite conclusively that the wall with the set-back for the colonnettes was built before the outer leg of the nave buttresses, and long before their ostium openings were begun. The ostiums were not begun until 1215. (There is no English work as succinct as the French *Guerite* for these sentry-like openings. So that I can keep their nomenclature separate from the very different aedicules of the choir I have called them ostiums). Colonnettes are an expensive and laborious device, yet are not uncommon. Why were they always placed above the level of the triforium? See discussion at the end of Chapter XIX, of the horizontal zones in the cathedral. The evidence for the primacy of the colonnettes is:
a. See n.7
b. The nave buttresses begun by Ruby inside the walls are wide enough to have been reduced with colonnettes. Their present width of 1,620mm would have been reduced if it was surrounded with shafts. Using the sizes found in the south, its width behind the colonnettes would then have become neatly √3 times the cross-wall, and the colonnette centres twice that (Bronze used almost this width for his sanctuary buttresses). However the nave buttresses were later erected as solid ones by Cobalt-S and Red-T, XII:10. That this was Ruby's idea may be confirmed in the aedicules which look like this in plan - n.47. Presumably the nave buttresses could have been narrowed like those in the sanctuary if there had been no plan for colonnettes.



c. The outside sanctuary buttresses were begun by Olive, with flanges on each side through which the drains discharge -XII:42. He could have intended to surround them with similar colonnettes. Their final solid form was determined by Cobalt.
d. Cobalt's simple square buttresses as in the triforium level of the apse - XII:42/h, and the way he reduced EN.IV in n.38 shows he was set on producing a non-colonnette solution.
e. Olive began the south wall of the SE(t) room with a thickness of 1,760mm. It is unnecessarily large, and so I presume he would have reduced it further up, however the north wall of the northern rooms are also thick, and they were not reduced at all. Olive's intention may have been to build a screen within an arch as can be seen today in front of the apsidal rooms, an idea that is implied in his plinths.
f. The possibility that Olive may have built a screen in front of the tower rooms is reinforced by course X in n.7. It extends under the outer part of the buttress and forms the plinth under the colonnettes, but the top edge is finished square without the mouldings found under the colonnettes round the walls or the other buttresses. Hence colonnettes were not intended at this level. Hence they were not the decision of Olive.
g. In conclusion, there is no evidence whatsoever that colonnettes were not to have been carried all round the cathedral. Between 1209 and 1212 there is nothing to show they did not intend colonnettes though there is not any absolutely positive evidence either. Today we tend to see the purpose of the colonnettes as an aesthetic device to help disguise the differences between the nave flyers on one side of the south transept, and the choir on the other. But remember that these flyers had not been started, and the big differences we see today were not envisaged at that time. Also, if the colonnettes were not intended for the whole building, but only for the south, this facade must have had a special significance. The open ended possiblities of this idea inclines me towards the first alternative.



Geometry XIII - A

The south tower rooms, triforium level, Scarlet and Olive, 1209-10.

Every master seems to have pursued a common policy in setting out the towers, which was to so arrange the walls at triforium level that the plan would form a square. The size of the square varied, as can be followed in the increments added onto the walls in the form of arches, colonnades, passages, and so on. It also varied as only two walls are at right angles to one another. Thus it is not easy to determine which parts the proportions relate to. So I examined each group of decisions made by each master, and then looked for the geometry that might have linked those particular decisions to the rest of the building.

We shall begin with Scarlet's scheme, though not much remains of it. In the SE room he set out the north end with square pilasters to support the vaulting ribs **k**. The top of his work steps down along the side wall until towards the southern side it disappears below the level of the floor at A and B, discussed in n.3 and 4. Olive finished the southern side of this room, and the whole of the SW, using radially aligned pilasters instead of ones set true to the wall. From the SW room I could extract Olive's style of geometry, and when applied to the SE helped me to distinguish his from Scarlet's.

Scarlet did not have a great deal of freedom as the bay had been established at 7,410mm by Bronze in 1197, and others had produced the wall thicknesses on which he had to build. I think his first move was to measure the bay at 25^{RF} (which is 7,365mm, remembering that on the south this would have been measured to an imaginary axis within the wall). He made the tower larger than the bay by his usual 6/5 ratio, to 30^{RF} or 8,835mm. This was measured along the two most critical sides: on the exposed southern face and where the tower abuts the interior, which also ties the tower into the major axial dimensions of the bays. The other walls are inclined to suit bent axes to buttresses, inclined walls etc.

East-west this would have suited the distance between the external wall E below the cornice, and the interior face of the triforium plinth T, to just within 50mm. The plinth P under the eastern arcade shown shaded was laid some years later by Ruby, and it overhangs the aisle wall by 30mm, and the wall over this W overhangs it by more than 50mm.

To design the room he divided the box into 50ths, and used nine for the east and west walls (8,835 x 9/50 = 1,590mm) with the marvelous consequence that the wall was exactly equal to the diameter of the drum he had planned for the piers in 1194, described in GEOM:VII-B. After subtracting the space for the passages on the east and west the two walls themselves have a combined thickness of one tenth of the box. On the north he made the wall one third of this, or 3/50ths of the box, and projected his pilasters from the same distance marked out from the corners of the wall, along the line of the ribs, which is why the sides of the pilasters are not equal.

Thus the east-west space within the tower compared to his exterior is 16:25, or 4^2:5^2, and the walls themselves which support the tower compared to the box is 9:25, or again in squares, 3^2 :5^2. In the triforium piers in GEOM:II-D the effective pier size is 1,570 x 1,335 and the extra 15% over the latter dimension may be the additional structure required to support the tower over and above that needed to support the clerestory - not much when you consider the loads involved, though he may have argued that if the height of the building to the roof represented six units, then the towers would be seven.

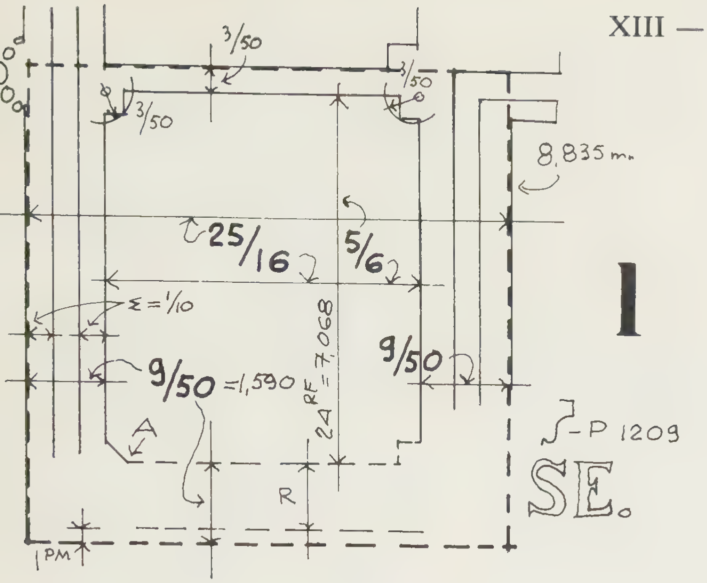
If he had intended to use the same ninths on the southern wall, its inner face would have lain precisely on the corner A of the last stone he had laid on the south-west corner, drawn in n.4. If he repeated the east-west arrangement north-south so that the combined thickness of the walls was two-tenths of the box, then the wall on the south, with thickness R in **l**, would have left a residue, or setback on the outside for a screen of shafts. This would have measured precisely 1^{PM}.

The room would have then formed a rectangle of the oft-repeated ratio of 5:6, and the long dimension would have precisely equalled the typical bay of 24^{RF}!

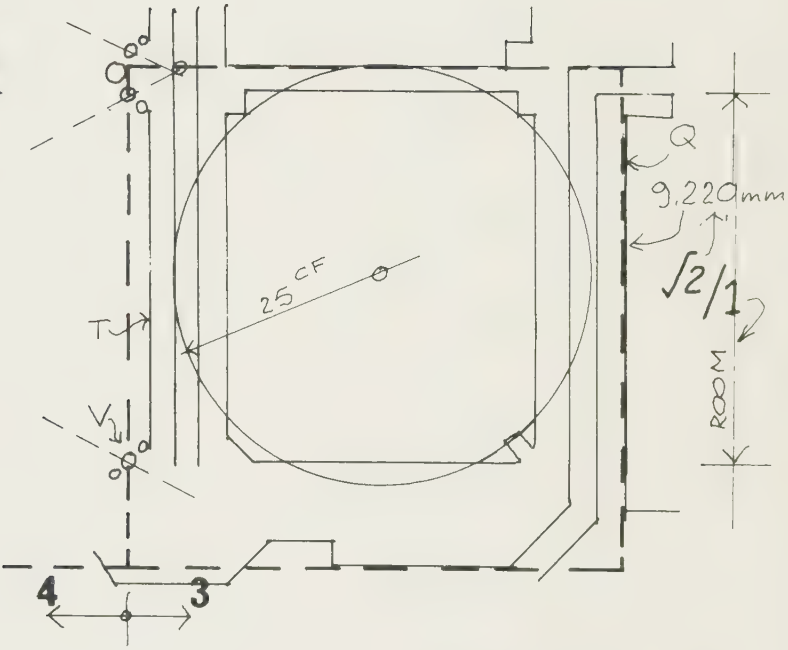
However this thicker southern wall was to be built by Olive, and if he had intended its thickest part below the shafts to represent the box, then it would have had a north-south measurement of a whisker more than 9,220mm, being the same measurement east-west from the plinth Q in **m** to the centre of the rib shaft V. Both would have been measured along the internal and southern walls. They would have expanded across the building to give ratios of 3:4:3. The box dimension is also 5/4 the bay, or perhaps 2: φ depending on how the bay had been measured. It is also neatly √2 the distance between the centres of the high vault ribs along V.

Alternatively Olive could have planned the recess built by Ruby in the next campaign. Working this time, not along the southern and internal walls, but along centres through the room, he would have produced the dimensions shown in **n**. They are approximations for the octagram figure at the top. When I tried to fit the octagram into the building the discrepancies between it and the actual building became too large, especially in the space across

l



m



the transept T-T, which at 12,808mm is 82mm less than the measured dimension. This approximation is good to see, for it is a practical way to set out a complex geometric figure at this height.

These dimensions are in multiples of his foot of 321.75mm (calculated from an average of the sum of as-built dimensions). In this the internal rectangle of the room became 18^{CF}:22^{CF}, and the latter is the typical bay as built. Is it possible that Olive may have calculated his small CF just for this project by dividing the typical bay into 22 parts?

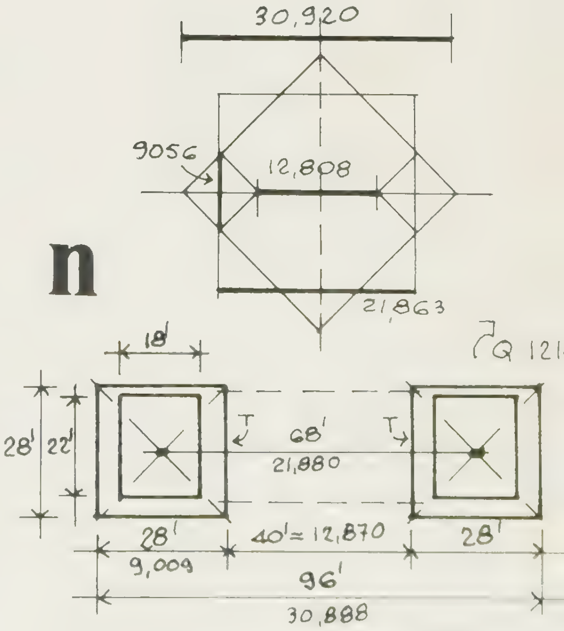
Lastly he placed his pilasters, in both rooms, tangentially to a circle measuring 25^{CF}. In the SE he drew the circle so that the corners of Scarlet's pilasters lay on the arc.

Ruby in the next campaign reduced Olive's thick southern wall so he could insert the screen of shafts, and if he had intended that this wall should represent one side of the tower box, the average dimensions through the centre of the tower would have produced a box 8,875mm square. This would have exactly suited the wall under the cornice E in **k**, and would have given these triangular relationships across the transept in **o**, between the walls ET (8,875 : 30,757 : 12,995. The latter is the dimension as calculated, and is also as measured). This box would then have been only 10mm less than 29^{EF} at 305.7mm.

No further changes were made to the tower box until Bronze placed the wall over the eastern arcade of the SE tower, and the arch over the west wall of the SW. The final box dimension of 8,935mm in **r** produced across the transept the same sort of ratios, involving eleven, as he had used in setting out the transepts in 1197, of 11:16:11 GEOM:III-B.

...XII-A/*XIII-D/XVII-A...

n



shown in the note.[7] Follow the sequence of doors and stairs from within the SE room: firstly pass from the room into the triforium passage, and on the left is the opening into the stairs marked SE(t). You have to go up four steps to get to the first tread inside the stairs 'd'. The one marked 'a' is going downstairs, and had to be laid by Olive with his walling. The next are by Ruby and include the stone marked 'c'. This is the lintel of the door underneath, which opens from the stairs onto a gallery which runs below the lancet windows of the end transept wall. To get to this door shown in the section you have to go up the four treads inside the triforium, and then wind down inside the stairs to come out underneath where you were.

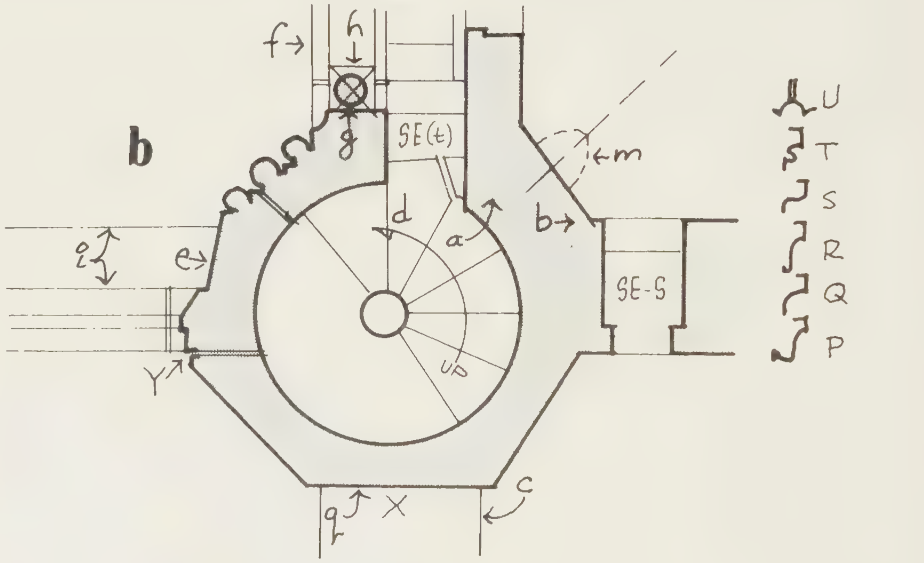
This gallery is like a continuation of the triforium at a lower level. It is not just to give access from one side of the transept to the other, for they could have used the outside walkway. Nor is it for the maintenance of the lancets for it is set so far below the window sill that you have to stretch onto your toes to reach the glass. Later galleries were set level with the triforium passage, but these at Chartres are more than a meter lower. It may have been put in to support this level of scaffolding, and perhaps to give access to it — though this could also have been achieved from the triforium passage. The clergy may have asked for it to suit some now forgotten liturgic device, or for hanging drapes and banners.

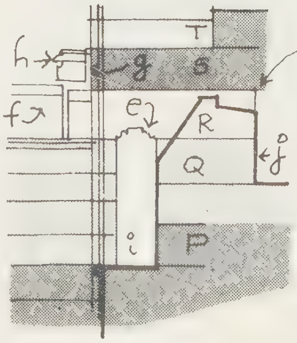
At Chartres it is a simple affair, and as in many contemporary churches like Braine and Orbais, its carved handrail is the only decoration.[8] In later churches the gallery was to become an important spacial device where the handrail was extended into a gigantic screen forming a second plane of tracery across the transepts. The first step can be seen at Reims and Essomes, probably in the early '30's, where the triforium was continued around the transepts. After this it only took another decade to eliminate the wall, and to transform its solidity into the amazing double screens of St Urbain at Troyes and the cathedral of Tours.

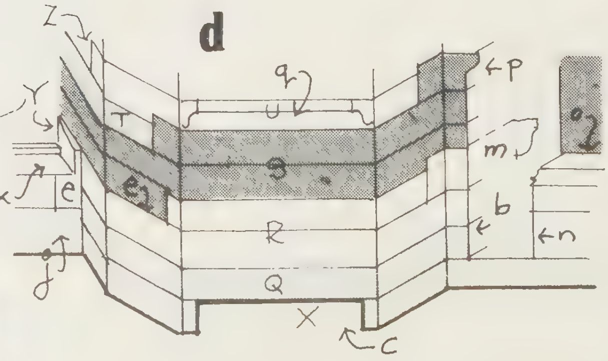
The Chartres gallery dates from 1209. It was begun by

[7] The explanation of the campaigns in the triforium level is complex, and more dependent on fine observations than any other. Hence here and in the next chapter the footnotes will be full of minor items which can only be listed. They cannot each be fully explained, but, if the drawings and photographs are not enough, they must be followed on site. In this note we shall explore the wall surrounding the SE(t) staircase.

a. Olive's topmost tread is placed level with the top of the plinth on the plan **b**. He laid the eastern side of the door without a jamb.
b. His join with Scarlet in the bottom course is drawn in n.4. With this he began the western side of the SE room-S door jamb, the depth of which is CFφ. See elevation **d**.
c. The cornices - XII:6/r,s - and the large stone X are buried into the wall and establish the width of the buttress at 1,905mm. See methods in GEOM:XIII-C.
d. The west treads are by Ruby-R, with the lintel over the gallery door. The infill stone next to 'a' is hatched.
e. The lintel is a large stone, with a splay over the door ending in a typical chamfer. This is seen best in the section **c**. It includes the eastern jamb of the lancet windows, which steps out from the plane of the wall at Y showing he had intended to run a small reveal around the lancets. This reveal was lost in the next course, and is therefore a joint.
f. As the plinth in the triforium next to 'e' is higher than the lintel, the base under the first column was pushed up. There is a change in the angle of its splay from 100 ± x 30° on the south to 117 x 33° in the plinth. As the coursing, texture and splay show that the southern stone is by Ruby, the north plinth must be his successor Cobalt-S. It suits Cobalt's splays elsewhere. See XII:10.
g. The next course over 'f' has a flattened curve in the corner instead of the usual half round. The shape of the curve was changed in the next course, and in combination with 'h' shows that there is a joint over the plinth by Cobalt-S in 'f'. The west side of the door into the stairs was finished with this stone $2\frac{1}{2}^{SF}$ wide. The splay is lined up on the newell as in Cobalt's WS-E(t) door -XII:4.
h. The base of the column overlaps both plinths, and is butted into the wall. It is later, and the curved corner of the base suggests that it is by Rose-U.







i. The gallery walkway was begun by Scarlet and the doors on to it - n.9.

j. The outside face of the sill is Olive, being large stones tied into his buttress. He began the slope on the inside. See 'l' for the stone tucked in behind his.

k. The top of the sill steps down to west of 'e', so I presume it was a new templet cut by Cobalt which continues to SW.III.

l. The length of the western angled face of the buttress alters at the corners. The lowest two courses are by Olive, the next is Ruby with Y and above that Cobalt. Notice that his course to the west is taller than Ruby's on the east.

m. Ruby's top course includes the corbel for the vault inside the room, and the start of the ribs - n.12. The corner of the room by door SE-S moves about by as much as 55mm, and the changes seem to reflect the changes in masters, though too much is damaged to make assessment certain.

n. The eastern side of the door is by Ruby to his standard size, 634 x 760mm or 5:6 based on 5″ unit of his EF - IX:29. There is a tumour on the right - XVIII:8.

o. The moulding steps back for the platform under the colonnettes. The shapes of the edge is identical to Ruby's around the sanctuary walls - VI:22/U and 52/S. The wall over was probably by Cobalt -GEOM:XIII-A. From the way the moulding is finished by the SE corner buttress Ruby intended to have a recess for the colonnettes 5,288mm long, or exactly 10^{EF} x $\sqrt{3}$. It was reduced immediately above the passage lintel by 42mm so that the buttress, after subtracting its colonnettes, would be the same width as those in the nave. Follow history of the screen, window and other parts of this wall later in the chapter.

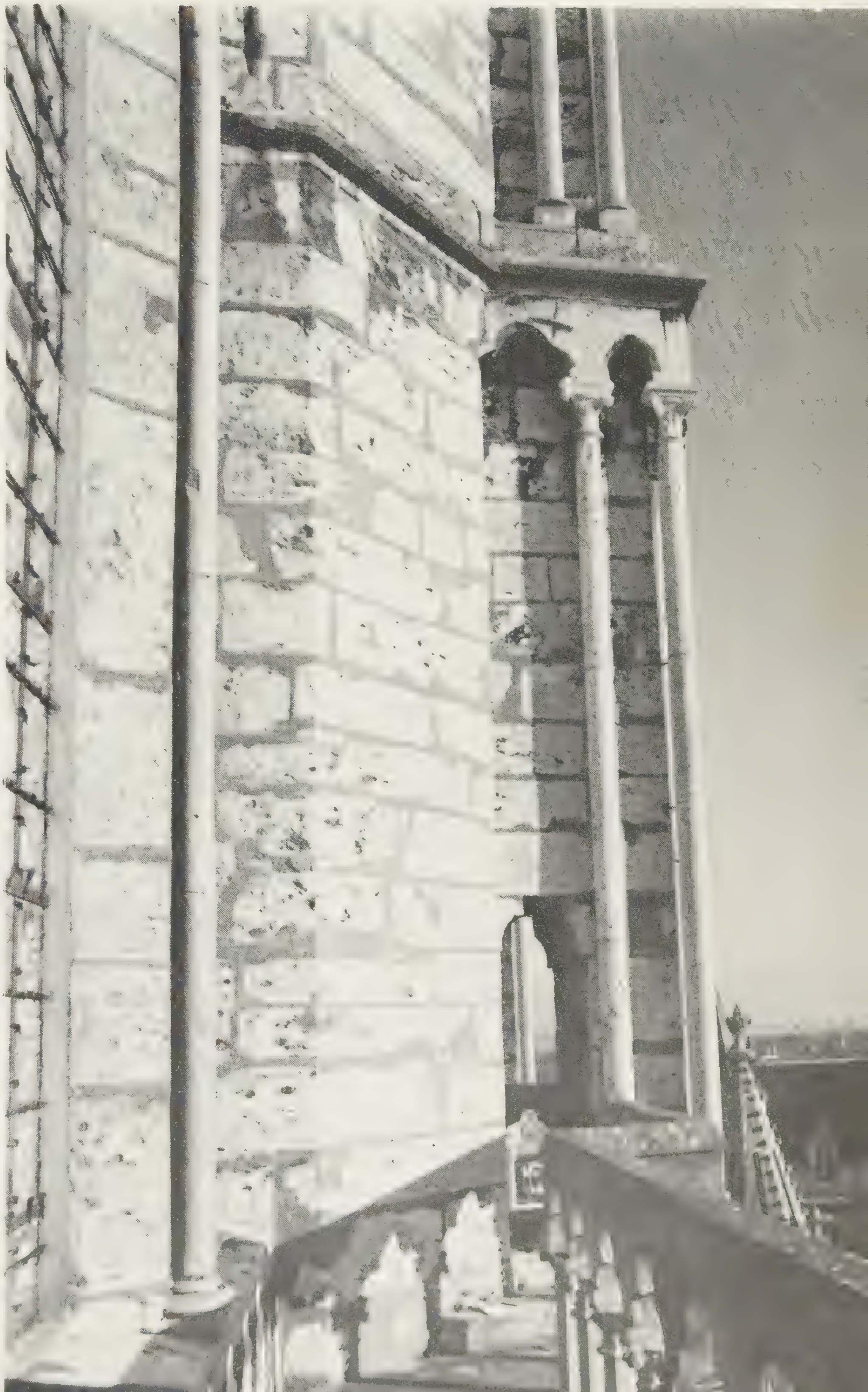
p. Cobalt corbels, with a break in the coursing as his work steps back to the west.

q. Rose-U placed his corbels over the passage and he finished to the west at Z. See elevation in n.56.

r. Similar analysis may be made of the SW.III buttress, though it was a little lower. Ruby there finished the course under the lancet sill, there being a change to the splay outside and to the gallery door inside. The stair treads by Olive and are all singles to the underside of the first double - n.54. The join over the SW(g) lintel is visible on the inside, and is Olive's.

8. The present handrail is probably nineteenth century, with capitals decorated like those in the south rose which was rebuilt at that time. I have not been able to find any evidence that it replaced an earlier handrail. The shafts which run up the inside face of the transept wall are incorporated into this handrail. They had been begun by Bronze-E in 1198. As Delaporte remarked, 1959, p.316-7 perhaps the triforium was to be continued without interruption from one side to the other as in the apse of Notre Dame de Bonneval. Perhaps there were to be slender lancets as at St. Pierre de Dreux. Perhaps the columns were to support arches over the walls.

PHOTO 303: The walkway outside the lancets of the southern transept. To the left are the sills placed by Olive in 1210 and the colonnette applied over the mullion which was inserted by him 13 years later. The angled face of the stair enclosure forces the walkway to the right. The corbels over the passage through the buttress are by Rose. The arches over the colonnettes encasing the buttress are by Jade in 1222.

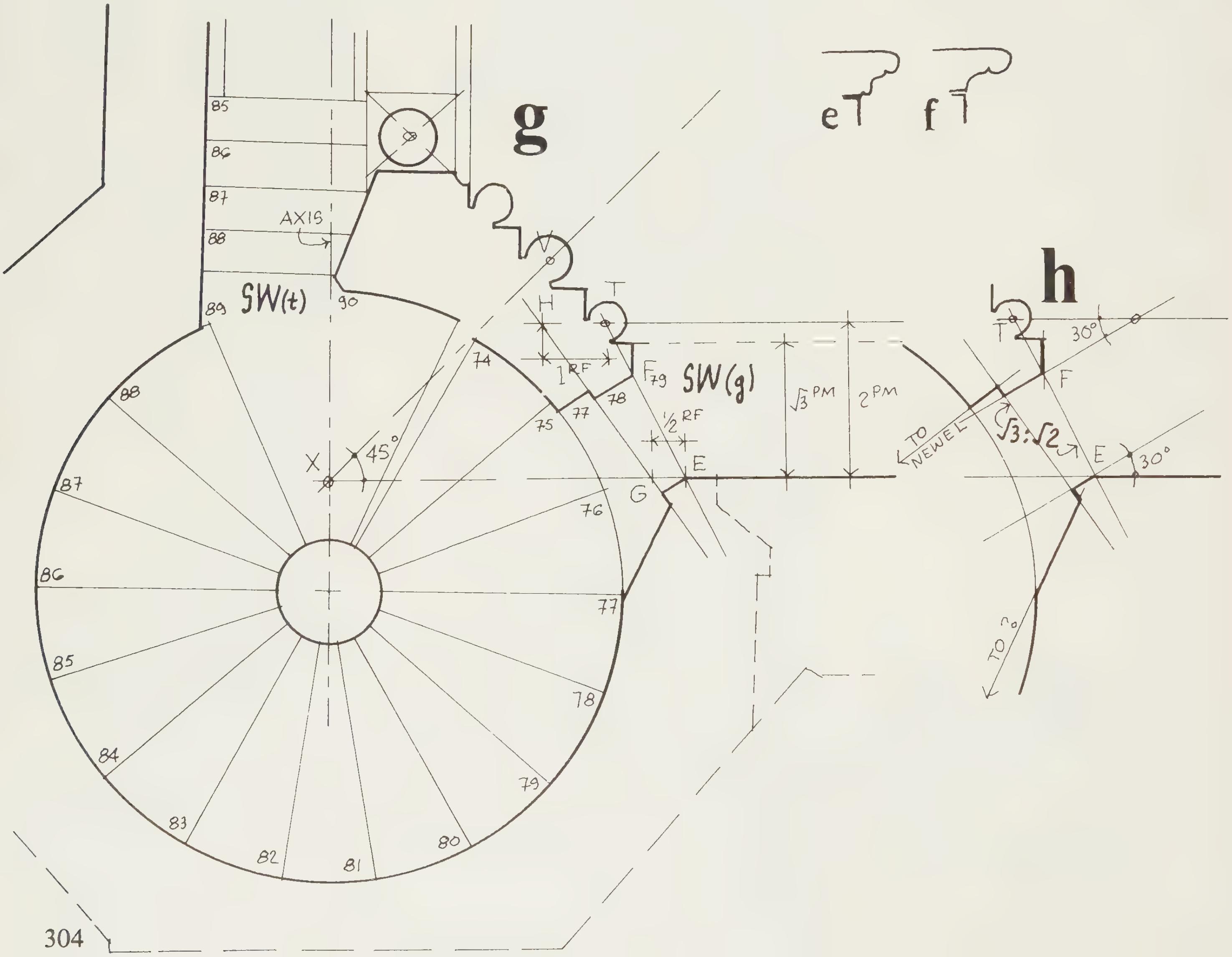


Scarlet who also set out the doors onto it with their cunningly arranged splays.[9] The head over them is low, even by medieval standards, but if it had been set at a more normal height it would have been above the level of the lancet sills and may have weakened the strength of the pier.[10] As it is, one of the lintels has cracked and shifted to one side.

When the coursing is traced all round these lintels, through the glass to the outside, and into the rooms under the towers, it becomes obvious that the five giant lancet windows across the transept were determined by Olive.[11] In most of the French churches built at this time the end walls of their transepts are as solid as possible with little more than a small rose set high up into the vaults. The prolongation of the rose down into the triforium may have been a natural continuation of the lancets used in the western ends, but the fact is that they were loath to open up this wall: I know of no other building where at this date the transept wall underneath the rose was so totally broken open as here. It was a splendid 'Gothic' solution to the problems posed by the heavy weight of the transept walls set against the increasingly airy construction of the clerestory. The blaze of glory which surrounds the rose windows in most of the Gothic cathedrals of France may have had its beginning in Olive's window-wall at Chartres, dated 1210.

While setting out the lancets Olive also began the SW room. He supported the vault ribs on bulging corbels which project from pilasters which follow the angle of the rib.[12] In the SE room the pilasters on the south side are similar, but on the north they rise out of ones which are set-square to the wall. These were begun by Scarlet when he set out the inner northern side of this room.[13] Scarlet began the room on the eastern side of the transept, but not the one on the west. Compare their geometry and you will see that Scarlet's design is characteristic, and is quite unlike Olive' arrangement in the west. Because Olive was forced to adapt his ideas to the work begun before him, and to the general form of the room established earlier, his work in the east was necessarily a compromise. In the west, though he was still conditioned by the walls underneath, he was able to create that room his own way.[14]

The pilasters under the ribs in Scarlet's room are placed square to the walls, but Olive's are inclined to follow the line of the ribs. In these pilasters, as in his lancets, Olive



shows how much more 'advanced' his thinking was, compared to Scarlet's. By placing them to suit the thrusts coming onto them, one is made much more aware of the dynamics of the vaults. The square pilasters are comparatively static and Romanesque. It is interesting to see how even fifteen years after he began the cathedral Scarlet is still working in rectangular forms and takes all his thrusts square-on. He catches up with the modern movement in a later campaign, but now in 1209 he seems to be one of the more old fashioned masters - competent and skilled, but without the feeling for light and movement understood by Olive.

The SE room is lit by an extraordinary tall and graceful window set neatly between the colonnettes on the outside. Its splayed sides are finely proportioned and the head is moulded from three conoidal forms which bring the lower parts into one splendid sculptural shape.[15] When measured I found that the splayed sides of the window are aligned to the ribs of the vaults opposite. Extend each side and they will coincide with the springing point on the other side of the room. It is a wonderful device for gripping the space and its parts. It was so easy to achieve, yet so difficult to comprehend without a drawing. We sense the order within the room, and we feel its presence: but we cannot know it. It hovers like an aura about us.

There is little in the cathedral that was not set out by geometry. Some stem from regular figures, many from simple numeric ratios, but most combine a number of shapes so that every part is derived from or is somewhere linked to every other part. The way they assembled their geometry seems to be more aesthetic than logical, as you can see in many of the geometric interludes. Though they may at times have been writing meaning into their work through geometry, they were more concerned with two other matters: the structural experience embodied in the rules and the wish, even passion with which they linked every part geometrically. In the process geometry seems to have stimulated their thinking. Many mouldings and shapes in the building only occur to express aspects of the geometric logic used to design it. These items were therefore, in a sense, created by the geometry rather than by artistic imagination alone. This is one of the reasons why medieval architecture is so much more fascinating than ours, for their geometry was an evocative tool, the use of which almost inevitably added richness to the design. The act of applying it forced the architect to think

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. The gallery was set a height of 13,850 above the floor, or 1½ times the height of the capitals - modular geometry again. The moulding at its edge **e** is not like the other triforium string courses **f**.

The geometry of the gallery and the door onto it from the SW stair goes like this: form the walkway width 2^{PM} to the edge of the string in **g** and $\sqrt{3}^{PM}$ to the wall underneath. When the wall face is extended into the staircase it meets the 45° line from the rib shaft V exactly on the axis. The length VX is 4^{PM}! For some reason I cannot fathom he fixed one side of the door jamb from the respond T, perhaps working towards his intended buttress which was not to be realised. The face of the door jamb TFE is inclined to the axis in the ratio of $1/\sqrt{2}$.

To form the inside reveal of the door he marked two distances: half the RF from E along the line of the wall to G, and a full foot from T along the edge of the string to H. By joining G to H he formed the inside of the reveal. The outer corner of the jamb F was placed where the face of the frame around the respond T met the line TE.

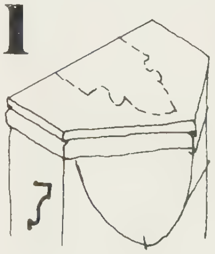
In **h** the sides of the jambs were placed at 30° to the line of the wall and string. Thus though the sides of the jambs are parallel, their widths are not. The width of the door reveal was formed from the opening by using his proportional dividers in his typical ratio of $\sqrt{2}:\sqrt{3}$. One side of the doorway was then oriented towards the newell, and the other possibly to one corner of his intended buttress.

0. The door height is 1,680mm. The height to width at the outside is $1:\sqrt{10}$ - an easy construction. Heights of both were set by Olive.

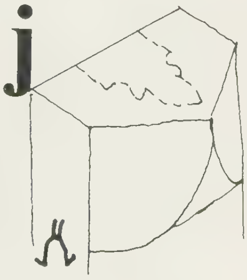
1. See n.7/j which shows that the splays on the inside of the wall were begun by Olive who may also have begun the bases for the shafts which now face the mullions. These shafts could have been one of the first to be placed over mullions in France, though the bases could have been added in later, perhaps as late as 1223 - n.62. The caps at the top of these colonnettes are Bronze-c, which suggests that the latest date for the bottom of the lancet mullions would have been a campaign or so earlier - see elevations in XX:32 and ISOS-c,d

12. The corbels are not the same in the two rooms. I have given the ones in the SE to Ruby from the coursing in n.7. They are shaped **i**. The ones in the SW room **j** are the work of Rose, also from the coursing and ES.I buttress - n.17/f.

i



j

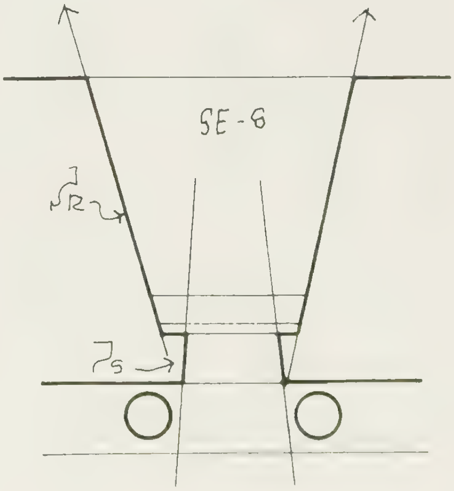


13. The SE room was ahead of the SW, reflecting the tilt in the work since the beginning. Other examples that show the tilt are:

The windows at tread 31 - IV:44
The Bronze windows in GEOM:IV-G.
The doors and windows over the porch roof - IV:45.
The towers in the clerestory in XIV:26.
The treads around the south rose - XX:32.

14. These two rooms are compared in GEOM:XII-A. In the SW Olive may have been further limited by work already laid below the present floor level, now hidden. You cannot build on nothing. Scarlet may have still had some influence over the SW - for the small projections under the west wall seems to be his.

15. The inclined sides were by Ruby - n.3. See plan of this room in GEOM:XIII-A for where they point to. The jambs were built with Cobalt's corbel, and have sides angled inwards at 95°. In the second course the angle of the sides was straightened by Cobalt's successor. The head was by Ruby-a shown in n.3/v.



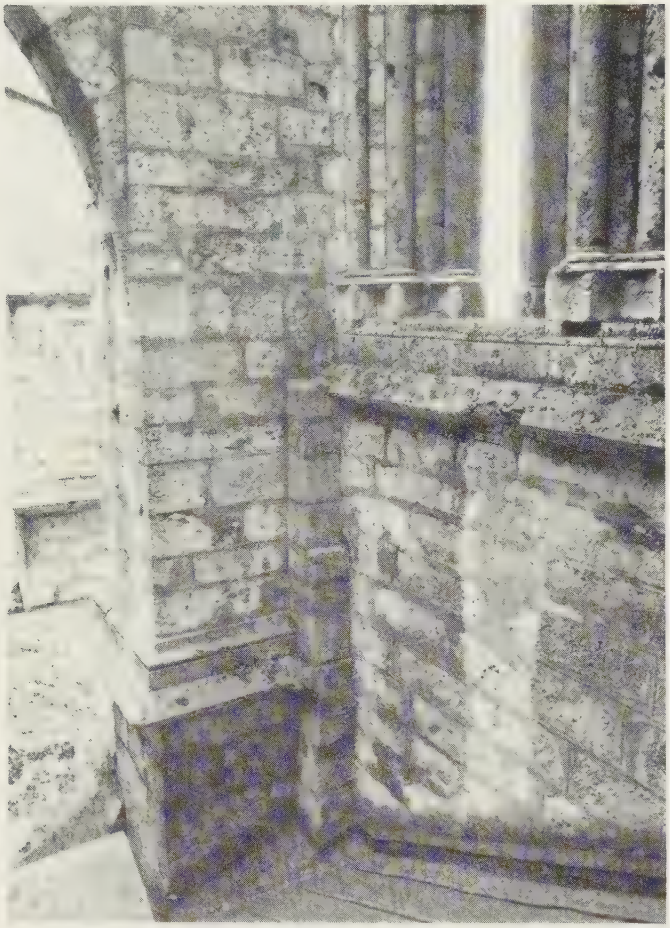


PHOTO 306: The north east corner of the SE tower showing the details discussed in n.17 on p.309.

further into his work, and stimulated him to greater endeavour. Architecture was not as easy to produce in the middle ages as it is today.

One of Cobalt's corbels sits next to this window. From the coursing on the left of PHOTO:303 you can see that the Rose who laid the corbels over the walkway came after him. Turn around and follow the passage to the east and you will find a Red corbel in the corner: turn to the plan and section at the beginning of the chapter if you want to locate it precisely. When the coursing is followed inside and out, through the doors and the windows, the order of masters becomes

- Olive in the lowest courses,
- Ruby under the colonnettes and down the eastern outside passage,
- Cobalt over the walkway,
- Red and
- Rose over the passages.

The walkway outside the SE room continues round to the east, jumps up a step and turns another corner into the sanctuary. The corbels are set low here, and you can easily bump your head. They belong mainly to Rose, and one of them has a lump sticking out of it which may mark a nodule of flint embeded in the stone. If they had chopped it out, it may have left a deep hole, for many holes are to be found in other mason's stones. It is a small detail, and its significance lies in the fact that it is unique to the Rose/Ruby group and is found almost only in courses which can be logically ascribed to them. Rose's policy of leaving these 'tumours' has helped me locate his work in other parts of the building. Here it projects from the curve of one of his corbels - an unmistakable identification.[16]

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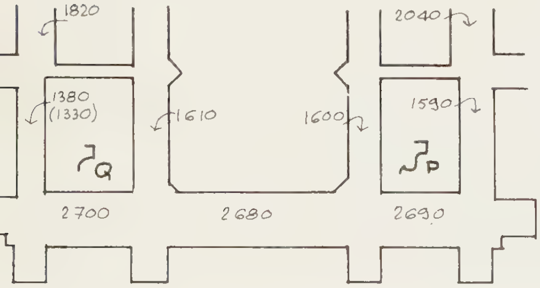
16. They also occur in corbels in NW.I(cw); cornice n.44; in choir (cw) walkway XVIII:10; mullions and walling. See list in XVIII:8

17 & 18. Both these notes are on the next page.

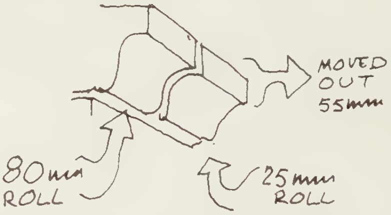
19. Here are the wall thicknesses, below the plinth level. Scarlet could have intended to face the wall with an arcade in the same manner as Olive has in front of the ES room - XII:42, or he may have wanted to leave it open with an arch over that as on the western side. However, it is interesting that the same sort of enclosed passage was also used on the eastern side of the transepts at Amiens and Beauvais and not on the western sides. Was it church policy?



20. As can be seen in n.18 the eastern passage columns were begun by Ruby-R and continued by Cobalt-S. There is a similar arcade on the eastern side of the NE tower, with Cobalt-Z plinth and Olive-d bases - XVII:27/h. From XII:41 Cobalt-S may have begun this corner with the outlet from the drain, so the northern solution may have been pre-empted at the same time as the south, compelling later masters, when that side had caught up, to continue the same solution. However, there is a symmetry about the flanking sides of the towers that suggests that what was built on the south would be repeated on the north. For the arched solution on the west face of the SW tower, implied in Olive-Q's walls, was also repeated in the north in Jade-b's walls eleven years later. Similarly the gussets inserted between the southern tower piers were repeated many years later in the north - XIV:3. They were not installed in the east, so presumably the axis of symmetry did not apply in that direction, which is discussed in the text after XIV:20. Also see text after XII:17.

21. The large arch across the west face was probably intended by Olive, for it seemed to have been a generally accepted policy to widen the towers as much as possible. The thrusts from the vaults could only be taken within the tower's width: so, after adding the triforium passage to the one side and the arch to the other the overall form of the tower became a precise square. Though slight distortions stemming from the ground floor modified this a little yet the dimensions along the outermost sides are all equal - averaging 8,920mm. See GEOM:XIV-C & D.

22.



23. Scarlet worked to the same √10 ratio between the cornice and head of the door, to the width of the door opening as in GEOM:II-A; while Ruby works 2:7 between the height between the internal floor and the underside of his corbel to the width of the internal recess as in his GEOM:II-C. See the section through this wall and the relative location of the corbels in stair diagram n.51.

24. Here are the reasons for placing Ruby before Bronze, which I discuss in detail because the method should be included somewhere no

The buttress round this corbel changes its shape nine times in a dozen courses.[17] Some of these changes lie below the level of the stone roof over the sanctuary, and others are above. I give reasons for some, and I have braved your scepticism to name the masters of each change, both in the text and in the footnotes. Doubtless you are wondering how so much may be inferred from so little, but just remember that these chapters are the synthesis of all I have learnt from across the entire building. I give you the results, not the process. It makes a heady brew, because it has taken so much and so long to distill. When I first examined each area in isolation all these little changes were confusing and bewildering. But I began with the major elements like the corbels and windows, the doors and cornices, and only after arranging them into a consistent pattern did I begin to link these smaller changes to each crew, and to get into the minutae of these footnotes. Doing it this way the little things became meaningful, and the minor alterations to elements like this buttress could be used to read the history of the cathedral. In this zone the analysis was complicated by the fact that it took ten years to build the walls from the paving to the passage ceiling.[18]

The decision to enclose this part of the passage with an arcade of columns was Scarlet's, for when he set out the SE room he placed the eastern wall much further from the edge of the walkway than would be needed for a passage on its own.[19] In contrast look at the way his successor Olive treated the other side. His wall is thinner without room for an arcade outside the passage. Here we have two contractors producing different conditions on either side of the same transept. Each began his own pattern, and those who came after had to conform or adapt as best they could.[20] Scarlet's wall was to be concealed behind an arcade, which would be emphasised by the deep shadows cast in the passage, while Olive exposed his wall and just decorated it with a screen of shafts.[21] The corbels over the west passage lie above the bases for these shafts. Nearly all of them are Scarlet's: the exception would pass unnoticed if you were not looking sharply. In the SW.II buttress one half of the outer corbel is a Rose, not a Scarlet. The fact is hidden because the whole stone has been withdrawn from the wall so that it lines up with Scarlet's adjoining corbel to give the impression that it was his, not Rose's. Scarlet's corbel has an 80mm roll mould on the bottom while Rose's is only 25mm.[22]

After Scarlet pulled the stone outwards the two outlines coincided so well it was over two years before I noticed the difference. This shows that though carved by Rose it was laid by Scarlet who was therefore the later master. At the same time he laid the corbels over the door into the SW room. Now this is not the same Scarlet as began the doors onto the gallery, for a number of masters worked in between - most obviously Olive whose corbels may be found just inside the room on the head of the door from it into the triforium passage. To complicate this picture there is another pair of corbels at the top of the recess for the outer door.They lie above Scarlet's and so come after him, and belong to Ruby-W.[23]

Open Olive's door into the triforium, stand within it and look to both sides: both into the triforium passage and into the room. Over the door into the stairs are two more corbels belonging to Bronze-X, and from the coursing he would be after Ruby-W over the outside door.[24] You will see that Olive's over the triforium door

PHOTO 307: *The eastern passage outside SE.III(t). See PHOTO: 242 for a view of the outside.*

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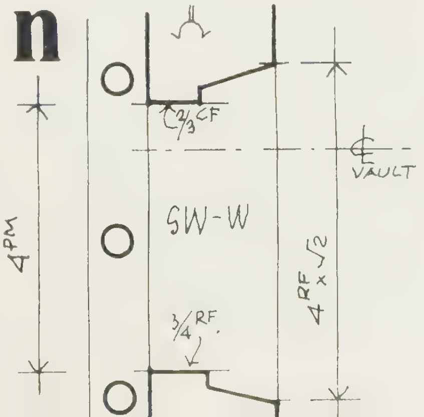
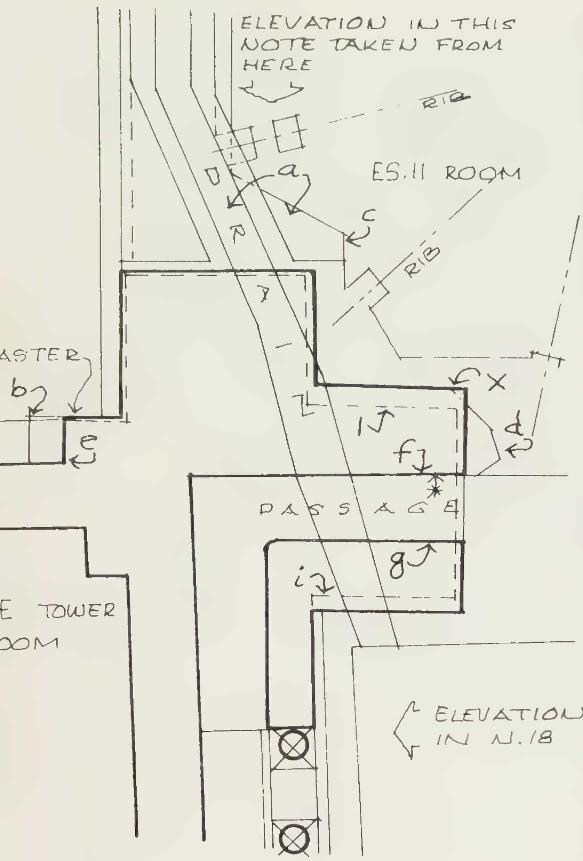
matter how abbreviated the form, and because it is one of the more uncertain cases. See n.23 and stair section n.51.

a. The order of the corbels in SW(t) zone, in n.1.
b. Suits the analysis of all the details in the E(t) tower rooms, especially in the arches and cornices - n.43.
c. It means that Bronze did the north 'arcades' in XVII:27, which suits similar details in the porch lintels, and the corbels over the top of the passage to east of the SE tower - n.3/u.
d. Maintains the SE tower ahead of the SW, which we would otherwise have to reverse.
e. SW.III-S window, being after the Ruby corbel, is therefore by Bronze. It suits his methods as in NW.III-W window where the window begins some courses below the sill, and where there are steps leading up to it, n.50.
f. This means that the SW.III-W window **n** must be by Rose, for its geometry does not suit either Bronze or Scarlet. Rather it is Rose in the north jamb, and Scarlet in the other as (1) the jamb measures 2 Cretan span on the north, but ¾ RF on the south, (2) the width of the opening, inside and out, is in Scarlet's units, and (3) as Scarlet altered the width the window is not central to the vault. Following courses it is clear that Rose's corbel in n.22 would have been carved with the north side of this window, and that the south side lies with Scarlet's corbels over SW.III.
g. When applied to the nave flyers this order gives the round-arched tops of the ostiums to Ruby (who always prefers round arches) and those with the trefoils to Bronze (who uses similar details over the SW colonnettes and in the aedicules over S(p)).
h. Ruby therefore did the corbels over the choir clerestory walkway, which allowed me to attribute the flyer arches with their splayed corners to Ruby too, which was confirmed by the width of the arches which he reduced from 708mm to 612mm, or 2^EF.

n





17. *Elevation of the SE.II buttress, looking to the south.*

On the left of the elevation is the ES.II room, and the right edge of the drawing shows the outline of the pilaster marked on the plan, and was presumably originally meant to support an arch over the north wall of the tower room. Notice that the plan is not oriented the same way as the elevation, for it is placed like the others in this book with east to the right. The heavier line on the plan represents the outline at the level of the corbels.

a. Footings and Scarlet's courses can be followed from the octagon pier over ES.II°, and the topmost course is indicated where he had intended that the buttress illustrated here should be 8mm larger than the one built in the next course. See XII;11 for walls, XII:41 for gutters, and XII:35 for rooms.

b. The north face of the pilaster is skewed.

c. Ruby's corbel under the drain - XII:41. It is tilted to sit on the earlier coursing, and supports the inclined part of the drain. Presumably Bronze would have run the drain straight, following the line of the wall underneath, and then bent it at the walkway.

d. There is a strange projection on the east side of the buttress, possibly by Ruby. From the junction of the roof with ES.III buttress, and from the flashing of this roof against the buttress, XII:35, it cannot be later than Red, and from n.34 and XII:32 cannot be earlier than Cobalt. Working down from 'e' and the step halfway up the wall on the east it must be by Ruby. Was it the jamb for yet another screen? Red's wall and roof in front of the ES.II room are shown dotted.

e. The pilaster was reduced in size by Ruby because it lines up with the buttress he later built higher up. The pilaster was enlarged by Red in the next course.

f. Rose-U corbel and tumour*. He altered the pilaster size again. On the ne. corner at X in the plan he squared up the buttress, and supported the corner on a bulging corbel just like those under the vault ribs in the SW room - n.12.

g. The Ruby-W corbel on the outside of this buttress in n.I/f indicates the position of the joint with Rose and another change in the pilaster suggests that the join with Scarlet-V lies partway along the wall.

h. Cornice by Ruby - n.44/b. On the west side it is turned up, pointing in the direction of the clerestory walkway as if it was to have followed the rake of the roof. It was to have formed a flashing over the roof, and as it stops abruptly there should be a joint over it. It is significant that in the northern rooms a related master, Rose-e, used the same idea - XVII:14/m.

i. The shape of the cornice was altered by Bronze-X in the next moulding, making each arm of the buttress the same width of 1,610mm shown dotted in the plan. The pilaster shows he did three courses.

j. Further change in the pilaster shows where Scarlet-Y took over. See further in n.3, 18 and isometrics, and PHOTO:306.

18. *Elevation of the SE.II outside passage from the east,* with its shafts and the wall around it to the cornice of the tower. For section - n.3. PHOTO:242 and PHOTO:307 for passage.

a. The cornice is by Olive-Q along the sanctuary, and under the arcade they are by Bronze-O and Cobalt-S, XII:6.

b. Plinths - XII:10/f. The moulded one on the left is by Red and it just butts into Cobalt's simpler one. See 'h'.

c. Gutters - XII:41; buttress - XII:11 and n.17.

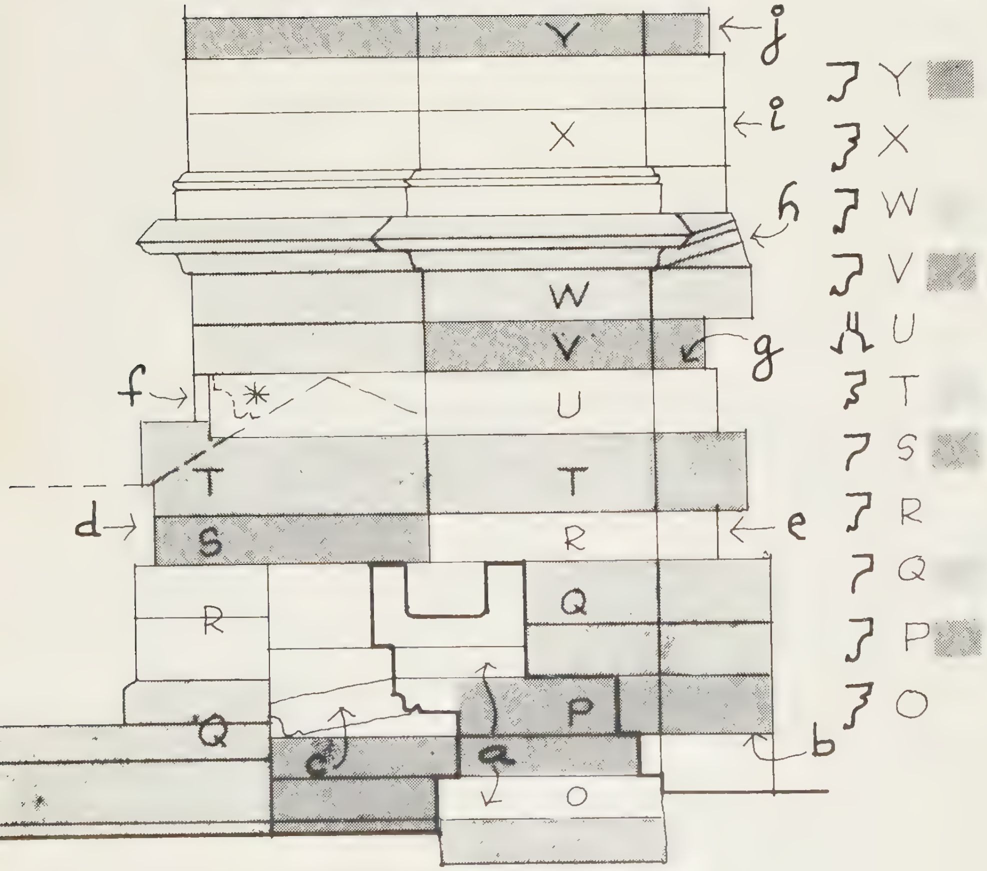
d. From XII:32. This plinth is Olive, and from n.17/d the next courses are Ruby. Inside the passage the corner is rounded off, except at the level of the drain where Olive had left it square. The ES.II room wall is Red, butted into the earlier work - XII:39.

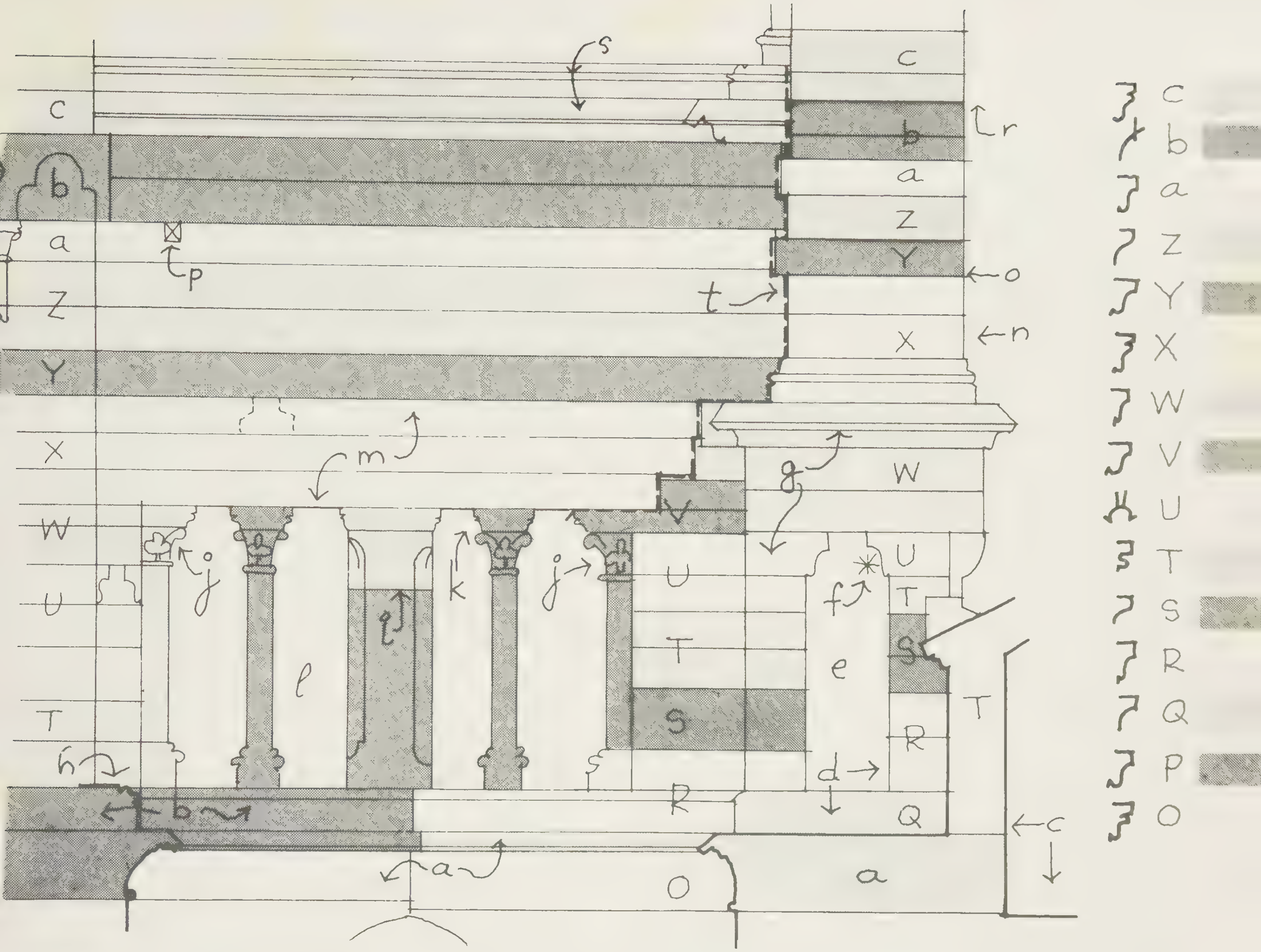
e. The coursing to the buttress and the adjoining eastern wall of the SE room (in section n.3) do not line up, which in turn do not line up with the southern end of the wall. The order of the work is very broken along its length. For a similar situation see XVII:22.

f. Rose corbels in n.1/f with his tumours -XVIII:8. Rose had set it out at $6\frac{1}{2}^{CF}$ above the paving at the north end of this passage and $7\frac{1}{2}^{CF}$ in the south.

g. Ruby's corbel on the outside eastern leg and he continued up to the cornice - n.17/h and n.44. See the joints on the left.

h. In the corner where one plinth stone meets the next the mouldings do not line up, and you can see that Cobalt had intended to build the corner (marked L in **k**) 80mm to the south. The arcade opening does not sit





in the centre of the wall, but to its south. From the ground it noticeably fails to line up with either the aisle window or the clerestory tower as can be seen in PHOTO: 242. Its centre was fixed from a string drawn from the centre of the triforium arcade T through the centre of the room R in **k**. As the triforium implies the high vault itself, the centre of the outside therefore expresses the alignment of the vaults, and hence the hollows within this bay. It is a nice detail but could only have been read by the initiated. The concept is Cobalt's, if not earlier. Small changes by Red etc. may indicate that other masters recognised its significance, but measured their centres a little differently. After all, neither the boss nor the full width of the triforium were yet in place, and their centres had to be established from a number of stringlines. A small movement in one could have made an appreciable difference on the outside. This shows how each master set out the job afresh each time.

i. The central rectangular post has unequal splays in plan **l**, and the bottom of each splay is finished differently. The leaf on one matches the leaf under a Cobalt corbel in WS-E(t). Also the proportions of the post seem to be based on Cobalt's SF. The upper part is finished with ribbed splays like Rose or Cobalt.

j. The capitals are probably Scarlet-*Squid* 340mm high, Cobalt*Zygote* 475mm high, and Ruby-*Frills* 410mm. The heights of the latter two are SF √3 and the English cubit.

k. One unusual impost **m** is identical to that over the corbel under the ribs in the nw. corner of the EN.IV room. By elimination could be Cobalt, Rose, Scarlet, Ruby or Bronze here, and in the EN room only Olive, Ruby, Cobalt or Red - so probably Cobalt. It is like his over the canopies in XVI:10. The same impost is used right through Brie-Compte-Robert, so? n.43/h.

l. The order of carving and laying cannot be disentangled here. Besides the three suggested attributions above, there is the problem of the spacing. The centres measure from the north 845, 1015, 1035 and 875mm. The larger space on the south could have been when Red moved the wall 80mm to the south, but why are the middle spaces larger than the flanking ones? They must have been set up by the time Bronze arrived, for why else would he have finished over them with a flat lintel?

m. Flat lintels Bronze-X up to splayed corbels - n.3/u.

n. Bronze altered buttress shape - n.17/i.

o. Top of Bronze's work from n.17/j. Scarlet-Y next.

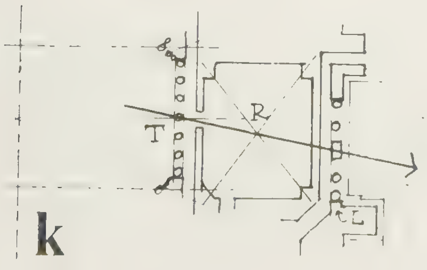
p. Putlock hole over Rose's band of work.

q. Camps and arches by Jade-b - n.62.

r. This is the top of Jade's work from the change to the pilaster on the west side which is visible part of the way up the cornice.

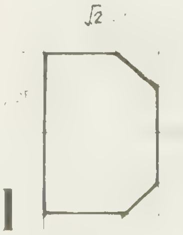
s. Cornice, plinths etc. of tower - XIV:26.

t. Notice joint up this dotted line.

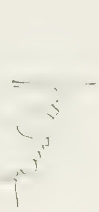


k

l



m



is a few centimeters below Scarlets in the outside door, yet because of the way this area was built there are five years between these two masters.

These five years, and their few centimeters, are a measure of the pause in these parts. Except for odd bits and pieces little had been done to these rooms after Ruby-R. It may have been decided to freeze further work on the transepts so all efforts could be concentrated on finishing the high vaults to the nave and choir - for the flow of funds seems to have been diminishing after a decade and a half of unremitting effort.[25] I would like to think that they put up a temporary roof to keep out the snow and frost. It could have been a lean-to from the triforium side discharging over the edge of the side cornices, and once there would have impeded any further work in the zone making it more difficult to continue with the rooms. The masters may have installed their site offices there with a plaster floor on which to trace out their designs. A brazier in the corner would have made it a snug yet convenient centre for the work in the triforium. You can see the roof over this section in the isometrics after chapter XVI.

Many scholars have wondered when the decision was made to build the nine towers which were to have capped the cathedral. Nine is the symbol of the celestial hierarchies in the Pythagorian and Jewish tradition, and this tradition was absorbed into Christianity. It refers to the nine choirs of angels - the seraphin, cherubim etc - and also to the Virgin Mary, for as Dante wrote "she is number nine, a miracle, whose root is the Trinity." The root of nine is three, so the Trinity itself forms the foundation for this number. But also, the arrangement of towers is eight around the perimeter and one in the centre. It is said that eight is not only the number of superabundant materiality being twice four, but it is also the beginning of the process of regeneration and of man's return to God, being the full cycle of seven plus the sanctification of one. In the Hindu tradition the seemingly endless cycle of birth, productivity and death which they call Samsara epitomises the hopeless entanglement of man in his material round. Liberation or Moksha is the spiritual path which rejuvinates man. In Hindu numerology eight signifies the point of departure towards either Samsara or Moksha. The use of nine towers, with the sanctifying one in the centre, could symbolise the benificent regenerative powers of the church used for man's salvation.[26]

However only two were completed, and another six left as stumps at roof level. In sorting out their intentions in the transepts there are no certain indications until we get to the triforium. At the ground level the buttresses under the towers are no bigger than the others, but can we say that because they are not enlarged they did not intend to build heavy towers over them? Personally I would have expected that the extra weight would have been expressed in their size somewhere, but I have no evidence of how they would have done it though it may turn up in some other building.

In this zone both Scarlet and Olive designed rooms which could only have been meant to support towers. They treated the terminal bays differently to the others and to the roof space. From here on we can say with certainty that the masters and the Chapter intended to build towers over the southern transept; but below there is nothing to assure us of their secret dreams: except perhaps that Scarlet who worked for them in the triforium had also set out the building fifteen years before.

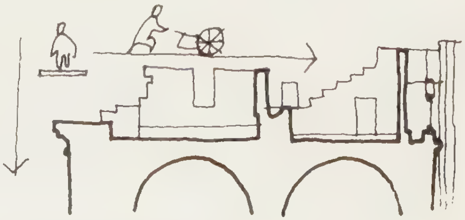
In the east the decision can be traced to a much earlier campaign. In the sanctuary two of the piers down the

25. See James, 1972 (3) and VI:45 for the cash-flow charts. In this article I wrote "the dip in the middle coincides with the military campaign led by Bishop Mouçon himself against the Albigensians in 1210. The smallest program of all - Cobalt-S - was in 1212 when all available funds may have been diverted to the war chests ..... Was the increase in tempo after the crusade due to booty sent home by the victorious Bishop?" Or did the fights between town and Chapter in 1210 have anything to do with the decline in funds? Perhaps as at Reims? See VI:70.

26. Dante's quote comes from his Vita Nova. In the Pythagorean and Jewish traditions nine is seen as the symbol of the celestial hierarchies. Dionysius the Aeropagite and St. Thomas Aquinas wrote on this. See Kollar, 1975, who wrote p.63. "The Ennead arranged around its Principle is surrounding it in a ceaseless flow of praise, beauty and harmony which activity is personified in the nine Muses of the Greeks" - Concord, unanimity, rhythm, order - these are the beneficient aspects of the Ennead." Van der Meulen, 1965, p.88 and 107 uses the east transept flyers to argue that towers were not intended, but just examine the history of these flyers in the isometrics for the answer to that.

27. Jean Villette, 1970, suggests an alternative IX:14. However the small buttress ES.II complicates his argument, for it is the smallest in the building, yet it was designed to support one side of the tower (Bronze both reduced it to its present size in 1195, and began the footings for the tower in 1208). Yet above the walkway of the triforium the buttress had been increased so it became the largest in the choir. Both the smallest and the largest - what can we prove by this?

28. Further, the wall containing his marks was thickened over a typical Olive corbel, to 455mm - n.43/f and GEOM:XIII-D.



SECTION AT ES.IV & ROOM UNDER TOWER.

30. For a number of sixteenth century examples "note the minutely detailed 'Tower of Babel', painted by Peter Brueghel the Elder about 1565, which shows many erectional practices of the times, together with the equipment employed. For example on the lowest level to the left, stacks of scaffolding poles are shown leaning against the foundation walls. To the right of this, a staged scaffolding is surmounted by a number of centering frames for an annular vault that is about to be built. Further to the right, on the next storey, are shown centering frames in face view, each with a support at mid-span which consists of a tall pole. Again to the right of this and at the next level, are to be seen centering frames of larger span, and shown in frontal view and with a central support ... There are a number of tall T-shaped cranes, as well as two great wheels - one, a huge double-wheel with a thick boom between - which are in the process of raising large blocks. Ladders, wagons of various sorts, a windlass, suspended scaffoldings, baskets, levers and other tools and equipment are depicted, along with a number of 'lodges' (and presumably 'tracing houses') for the workmen and designers. ". Fitchen, 1961, p.223. Also Salzman, 1952, p.320 & Colombier, 1953.

centre of the aisle are cylindical, and smaller than the others. They could have been continued into the next two bays, as they were around the apse, but two heavier *pilier cantonné* were built instead. Their purpose is obvious: they were to take the extra loads of the towers - and if they could in the east why not in the transepts too? However, above the level of the pier plinths on the ground floor there is nothing to show whether they contemplated changing this decision or not, until we come to the same level as Scarlet's southern rooms.[27]

In the east the foundation walls under the towers are much wider than any of the others, and show that towers were intended. These foundations were begun by Bronze, along with his Greek-cross type buttresses. On the outside they were completed by Scarlet, and the drains were laid over them. Above this lies the signed work of Olive, for his mason's marks identify him.[28] You can follow the work around these towers in the isometrics, and you will see that Olive rapidly raised the side walls and the inside wall of the tower rooms. The outer wall was not as high, and the amount of work done to the rooms by most of the later masters was much less than what Olive had done in this one campaign.

The section shows that the walls of the room were brought up to the same level as the triforium passage,[29] and that for the first time part of the perimeter of the building had been raised to the same height as the interior passage walls. The normal tilt across the work from inside to out had been altered. Something must have complicated the work to make them push the tower walls so far above the level of the surroundings and some 2½ metres above the nearby stairs. The arrangement seems to have served only one purpose: scaffolding.

In trying to re-create the conditions on the job at this height, I realised they would have had to have a wide platform around the works, wider than the walkway, and preferably above it. By raising the walls of the rooms above all the work roundabout they could used it to secure a permanent platform. The platform would have passed above the level of the rest of the work. It would have been high enough to feed the men now working on the walkway of the clerestory without interfering with what was going on underneath. I have shown the gangway on the section. It could have been built to last, as it need not have been moved for seven years. It was logical to use the room walls to support and to stabilise such a permanent gangway.

If Olive had erected the gangway in 1210 it would not have prevented Scarlet from forming the arches around the rooms in 1215, nor would it have hindered Ruby in the next year when he was beginning the choir flyers. It may have been demolished in 1216, for shortly afterwards the rooms were to be vaulted, and the next level prepared for the tower piers.

Even today when we use much more sophisticated equipment, such as mobile cranes with long cantilever arms and means for pumping cement and for moving materials round corners in pipes or conveyers, the arrangement of the hoisting devices has a marked effect on the way the building is put up. Medieval builders did not have heavy gantry cranes, and they had to move materials by hand or by barrow. The location of their major hoists would have profoundly affected the order and the rate of construction. Their major cranes were built of timber, and consisted of a large wheel within which one or more men could walk, and by rotating the wheel raise the stones.[30] The heaviest weights could have been lifted in this way. One of the wheels seems to have been built on the ground below the apsidal tower close to the third buttress. The stones would have been first raised

Geometry XIII-B

Buttresses around the southern rooms

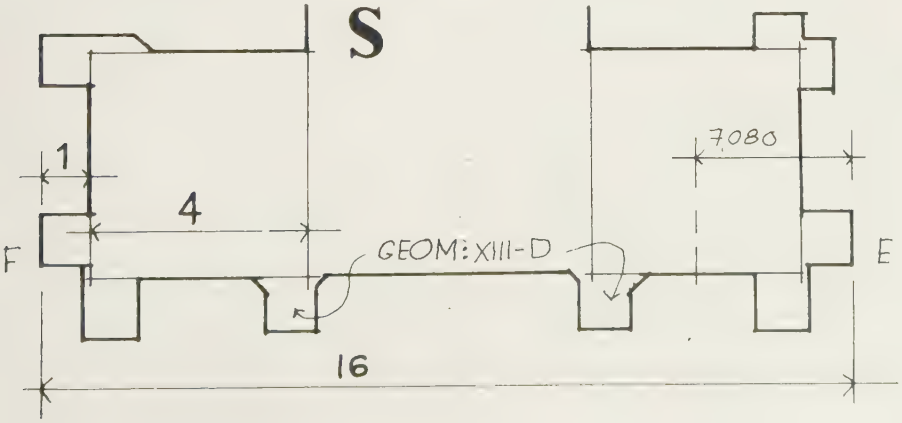
The dimensions and axes in the buttresses surrounding the towers are too varied to give a seemingly clear geometry. The factors affecting these dimensions are also very complex, coming as they do from the many altered sizes and axes on the ground floor. However a few things do stand out:

1. The full projection of four of the buttress outside faces from the tower box is on average 2,230, or one quarter of the box measured along the southern face, which is 8,930mm.
2. The SE corner E in **s** projects 390mm more than the others, but the overall EF is just four times the box. Was this eccentricity deliberate to maintain the ratio?
3. The buttress E plus half the box along the south side is half the typical bay.

So it would appear that these buttresses were added onto the box of the towers in the most convenient way to suit the misshapen towers, and with no regard for the distance between the epicentres and axes. They may have argued that as long as they were further out than geometry required, then they would function as well as if they had been correctly placed.

Note that none of these buttresses lie on the same centres as those below the cornices. SW.II is not oriented along the line of the tower wall, nor to the nearby vault shaft S, but to the shaft on the opposite side of the transept. This is just the orientation used by Cobalt in the nave buttresses discussed in GEOM:XII-H, and so raises the possibility that this plinth may have been his. The SW.III buttress points to the centre of the opposite staircase, and the south leg of the SE.III not to the opposite buttrress of the tower, but to the octagonal support under the choir flyer at ES.I°. Around the stairwells the wall faces are more complex and will be discussed in the next geometry.

...III-B/VII-E XII-A/*/XVIII-B...



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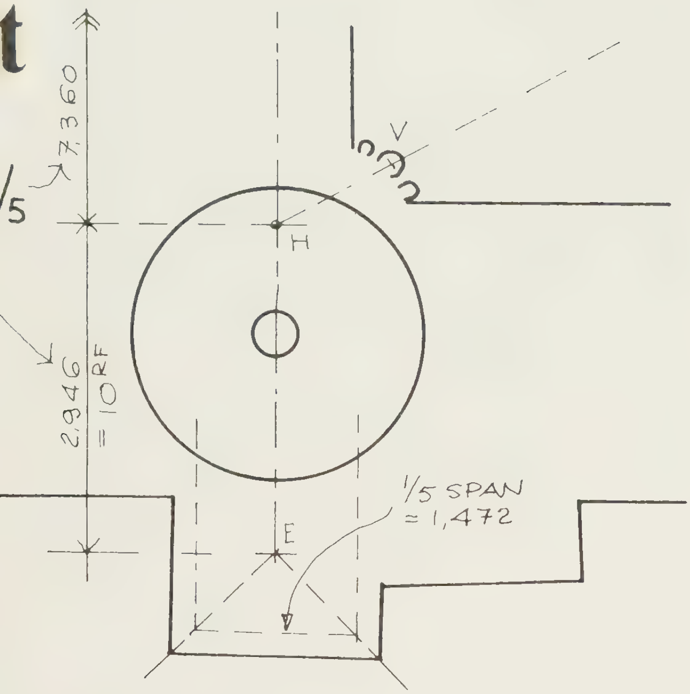
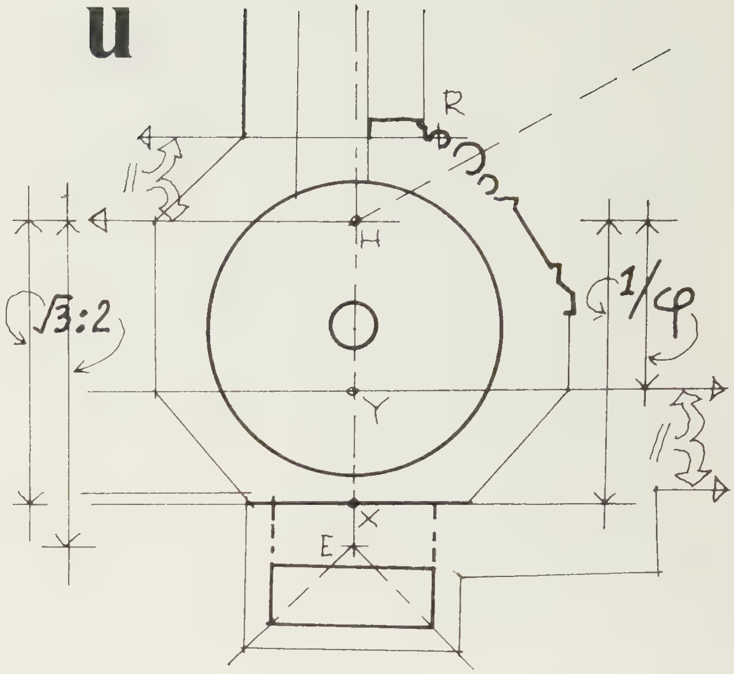


u



Geometry XIII-C

The south transept stair buttresses, Olive-Q, 1210.

I measured the angles of the walls around the stair buttresses with long lengths of string run parallel to the walls, and measured back to known points long distances away. The walls are seldom aligned to one another, but there is a reasoning behind the design. They illustrate the way in which walls will be deliberately inclined to one another, and that they are not mistakes, but policy. I shall illustrate both buttresses from the SW, and though the SE is dimensionally different to the former, each part can be derived through exactly the same geometric process.

The projecting outer part of the buttress was positioned by Scarlet in the earlier campaign, from the H axis in **t**. The point marked H is where the actual line of the high vault rib met the axis through the *pilier cantonné*. The epicentre was placed 2/5ths of the bay from H, and its width is half that. The epicentre is not only precisely 2/5ths of the bay from H, but that distance is also 10^{RF}. Olive placed his epicentre above that.

Above the walkway the shape of the buttress was changed to an 'octagon' which comes from an arrangement of eight encasing string lines. Four of these fixed the faces placed square to the walls, and four fixed the corners from which the angled faces were formed, just by joining. In **u** the four horizontal lines have been drawn:

- The face X was exactly placed so that $HX:HE = \sqrt{3}:2$, and was oriented square to the string drawn from the epicentre E to the crossing. Though the crossing is a long way away, it was the only item which could explain the angle at which the face X had been placed in both buttresses.
- The line Y was placed so that $HY:HX = 1/\varphi$, and was oriented parallel to the external wall of the transept.
- The line through the wall respond R was placed true to the wall of the triforium arcade, and
- The line from H was oriented parallel to the one through T.

In the next drawing **v** I have combined these lines with the other four placed from the inside towards the outside to show how it all fits together. In these other four:

- The line through the high vault shaft V was placed square to the outside of the wall of the transept and the Y line.
- The line T lies 1,965mm from V and parallel to it. This is two thirds of the length HE, and is the triforium and *pilier cantonné* dimension in GEOM:II-D.
- The line U on the right closest to the rose window was placed half this distance of 1,965mm from V, and was oriented parallel to the left or *inner* side wall of the triforium passage, and
- contrapuntally to that, the line W on the left next to the tower room was placed the same distance on the other side of T, and was oriented parallel to the right or arcade face of the triforium passage. It so happens that in the SW the difference between these two angles is quite marked.

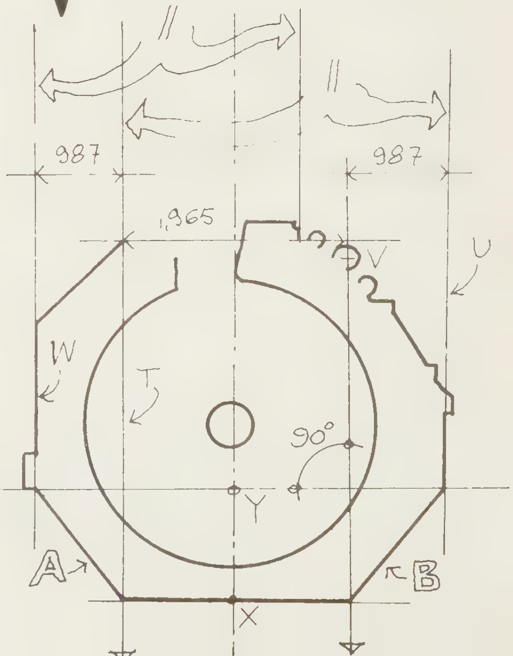
From this drawing you can see the eight strings which would have been laid across the site. No drawings would have been required, and this may be typical of the way the masters made most of their decisions once the work was up in the air - measure up and place string lines in position, rather than in the office.

What Olive has done is to relate the A and B splays to the triforium at the one end (where U and W meet Y), and to the outside wall at the other (where T and V meet X). He could have reasoned that A was placed to suit the tower side of the passage, and any thrusts coming from it. Similarly that B related to the columns on the inside. The splay then relates the vault thrusts through H to the triforium wall through V. It is as if these walls are in tension from the loads on them, and that like a stretched skin of a tent they will be secure as long as the edges are tied into the structure in the right way, with just the right touch of magic.

He may have visualised the buttress as a Greek Cross which, except for the stairs, would have been left as a cross. But to fit the stairs inside he turned the cross inside out, as it were, and filled in the corners.

...XII-F/*/XV-A/XVII-B/XX-C...

V



XIII — THE TOWER ROOMS

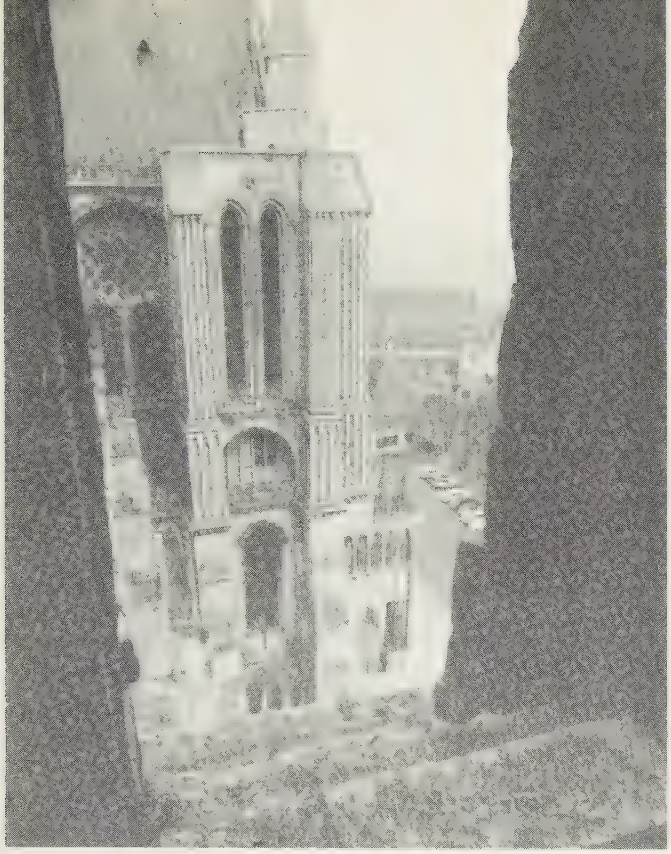
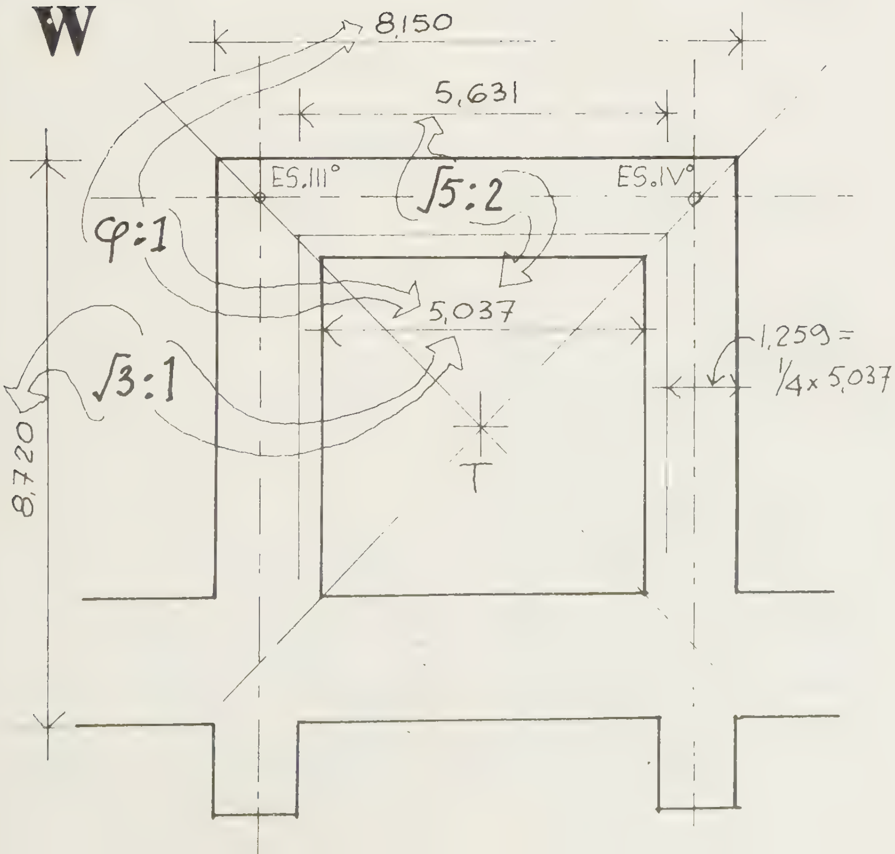


PHOTO 313: The SW tower seen from the eleventh century WS tower. The room at triforium level was ideally placed as a tracing room and site office for many years.

Geometry XIII-D

Apsidal tower plan by Bronze-O, 1208.



Bronze-O seems to have laid out the lowest courses of the tower, as can be seen in the elevation in n.43. He located the centre of the tower T in **W** equidistant to all the axes passing through the aisle piers ES.III° and ES.IV° which can also be seen in GEOM:XII-B. Around T he drew a square equal to the aisle span of 8,150mm. This placed the outside of the footings.

The inside of the footings was then reduced from this by $1/\varphi$. The inside walls of the room relate to the latter in the ratio of $2/\sqrt{5}$, which is of course the figure needed to construct the φ of the first ratio.

This left a footing width which is exactly one quarter of the smallest square. The actual average dimensions suit the mathematics exactly. ($8{,}150/\varphi = 5{,}037$; $x\sqrt{5}/2 = 5{,}631$; $(8{,}150 - 5{,}631) = 1{,}259$, which is ¼ of 5,037!)

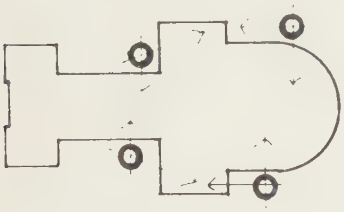
The southern face of the room lies on one side of the first square, and the thickness of the external wall was determined between that and the outer face of the wall underneath, which had been fixed many years before. However the consequence of this construction was that these two dimensions of the tower relate to the smallest square as φ and as $\sqrt{3}$. The 8,150 dimension is naturally so as the two units in the first square was reduced by a consistent Golden Mean construction.

Higher up Olive reduced the size of the tower room by corbelling out the wall, n.28, so that the inside to outside dimensions would relate as 6/7. When the arches in n.43 were begun over the walls the overall dimensions of the tower box became 7,850, and was the work of either Scarlet or Ruby. This enlarged size followed one of the commonest ratios used in towers from one end of Europe to the other, being $\sqrt{2}$ times the interior. See GEOM:XIV-A for description of Scarlet's final arrangement for the clerestory stage of the tower.

...XII-A/XIII-A/*/XVII-D...

31. The apse is an exception. It was always the lowest part of the job, and remained retarded to the end.

32. The location of the cranes, and the use of tunnels for access into the crypt to bypass the builders yards discussed in VI:62 was first suggested from the delays in the nave sills in X:13 and in the omitted portions of the triforium cornices in XII:6. Other indications are the modifications to the walls around the apsidal towers discussed here; the coursing of the eastern walls of the SE and NE tower rooms, especially XVII:22; the sequence of construction, starting with the bays furthest from the cranes in the vaults in XI:34 and the nave flyers in XVIII:49 and 64. The influence of the cranes on the order of the work can be traced back at least as far as Ruby-F, and can be followed in the isometrics.



33. In the quantities I took out on the building with the help of Ken Green we calculated that the total weight of stone to be lifted each day would have been in the order of 45 tonnes (James, 1972(3)). Each crane had to handle 11 tonnes at say one tonne or so per hour. The average weight of the stone blocks vary from an eighth to a quarter of a tonne, and assuming that two of the smaller could be raised in one lift, we need four lifts per hour. This does not include the hoisting of scaffolding, nor of the prodigious quantities of lead for the roofs, nor of iron which may have together weighed another 1000 tonnes.

For the giant blocks weighing many tonnes each, extra men would have been detailed to walk in the crane, and the work of loading and unloading would have been slower. Knoop and Jones record the hours worked during the winter and summer, and they vary, as does the pay. Twelve hours is the average summer working day, but only six or eight in the winter. Stones could not be raised in inclement weather, nor could mortar be laid in snow or frost.

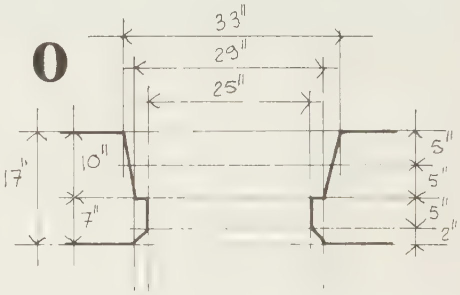
34. One confusion that gave me a lot of trouble was the assumption that all the Rose-like corbels over the sanctuary buttresses were carved by the same group. I finally separated them between Rose in 'U' and his associate Ruby in 'R', after which all the inconsistencies fell away. As in n.24 I am setting out below an example of the detailed arguments needed not just in this, but in every case. It would be tedious to set them all out but you may as well share in some of the sweat that went into this study!

a. The joints in the coursing. Following on the analysis made of the eastern tower rooms in n.43.
b. The gables in front of the EN.II and III rooms must be after their dished drains, and so after Ruby-R. The second room is built into the EN.III buttress just over a Rose/Ruby corbel, and this corbel was put in before the arches on the west of the tower rooms - illustrated in n.43. Also, from the coursing, it comes before Red's corbel over the door into that room. So the inside one is Ruby, and the outside will be Rose with the gables.
c. The roofs over the south sanctuary rooms were built before the buttress corbels, and if they were finished by 'R' the work in these rooms would have been done by too few crews to explain all the alterations.
d. The offsets up the face of ES.II and III buttresses can only be explained by putting their corbels into campaign 'U' - XII:42.
e. There is no consistency among the plinths under the sanctuary buttresses if the corbels are 'R' - XII:10.
f. The edge of the roof over E.VII room is butted against the jamb of the ES-N door, and is therefore after Ruby-R. Follow this problem with the roof under Rose's corbels by the ES.I buttress - n.17.
g. The EN buttresses are not altered in each course as on the south, so my final conclusion was that the EN.II and ES.III inside corbels must be before the Red over EN.IV tower room door, and so 'R'. The rest are 'U'.
h. Careful measurements with full size templets show that though each group of corbels are similar, the curves are a little different, and all of Ruby's in 'R' measure 179-183mm across the top, while all of Rose's measure 186-189mm. These are the only masters whose corbels are so similar that I have had these problems - IX:33.

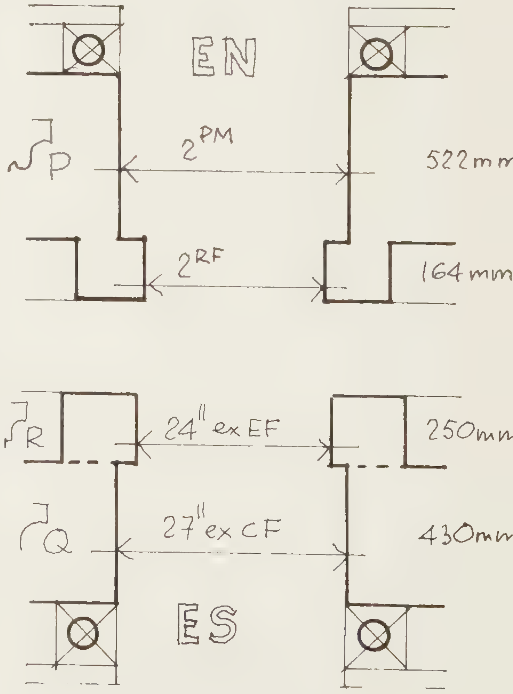
35. On the west side of ES-N. You can follow the joint down the inside of the stairs towards the sw - XII:42. Cobalt uses a large holograph from 400-520mm with well finished faces.

36. The E(t) tower rooms:
a. There are three windows out of the south room, but only two in the north. Olive's marks can be traced around all 5 windows and in the lowest course of the blank wall - but not at the level of the sill of that wall. This shows that he began the wall, but did not reach the level of the sill before leaving the job, and that the next master left this window out. The geometry of the window seems to be based on his inch of 26.8mm ex his CF of 322m **o**.
b. The doors out of the rooms were started by Scarlet in the north, and by Olive in the south with his plinths - XII:10. The joint in the north runs under the centre of the wall -Scarlet laying doors with jambs of his usual 2^{PM} x 2^{RF} pattern, and Olive an unrebated opening 27 inches wide **p** on the inside of which Ruby later butted two plain stones to give it a jamb, 2^{EF} apart. Above Olive's coursing the jambs are bonded in. Red, in finishing off the tops of these door with his corbels, took the external width and repeated it four times for the height to the lintel. The little coping over the inside of the door may be the work of Rose.
c. The corbels which support the ribs are full-bellied ones, and thus belong to Olive. They look like the simpler ones he carved in the crypt chapel I - VI:17. They have his mason's marks around them, and line up with the reduction he made to the octagonal buttress, and his thickened wall - n.28. The identification of the other corbels can be seen in the isometrics.
d. The ribs are 330mm wide, with simple 45° splays on each side - Ruby-W from 'f'.
e. The ribs are circular and the cells follow the form of the arches to the outer walls - pointed on the short sides, round on the long. The marks of the formwork are still visible showing that the cells were supported on many short narrow planks, each separately strutted to the floor.

o



p



from the ground to the scaffold, and then carried or wheeled along the horizontal gangways. The work furthest from the crane would usually be built first, as with the aisle vaults.[31] As the parts furthest from the crane were raised above the level of the gangways, the scaffolding would be progressively altered, and raised to a higher level. I do not think they would have removed the cranes during the work, but only the ways leading from them. The cranes were sturdily built, and we know of some which have lasted for centuries. The same wheels could have delivered the first stones to the sanctuary and the last capping to the choir roof.

I have chosen the third buttress rather than the fourth because in later campaigns the stairs were pushed well ahead of the tower room, while the buttress to the west was kept back. It was while they were finishing the vaults over the tower room that they had to keep this corner lower, presumably so that materials and filling could be delivered, and so locates the crane adjacent to the third buttress.

This would not have been the only crane. I calculate there would have been four altogether, arranged like this.[32] The work was therefore divided into four zones. The two against the nave were placed against the transepts, which is why the western end of the nave continued to be in advance of the east, and why the SE end of the southern transept was ahead of the west. The slowest part would have always been nearest to the crane, as can be seen in the slow completion of the walkway cornices in this corner. Some strange things happen at times near the cranes, and when you analyse them you find that the explanation usually has something to do with the means used to get materials from them to other parts of the site.

This would have been one of the main factors forcing the builders to raise the work in regular layers, without trying to even out the work, or to push one part ahead of another. The cranes were by their nature slow beasts, and as the work rose higher may have been the limiting factor in the possible speed with which each part could be built. I have calculated, subject to a few guestimates, that four cranes could handle all the masonry for the job at a rate of about thirty lifts per day, or about one every twenty minutes. Allowing for breakdowns, difficulties in handling, bad weather, and periods of slackness while the scaffolding and pulleys were repositioned or repaired, and the unforgettable fact that they were worked by footpower with a concomitantly slow rate of hoisting, I think that a rate of one lift every twenty minutes might not have been too slow an average.[33] At this rate they would have had to raise about a ton or so of stone each per hour, which may have averaged three stones per lift. From this we can see they would have needed three erection gangs working around each crane, and even this may have caused more confusion at the unloading platform than our standards of efficiency would contemplate. No wonder the position of the cranes affected the way the building was put up.

Returning to the eastern towers, there is evidence for the work of many masters in the walls around the rooms. Rose added the buttresses, and corbelled over them,[34] Cobalt set up the door jambs leading out of the stairs,[35] and some of the rib springing blocks within the rooms.[36] The octagonal piers outside the corners which had been started by Olive were continued by Ruby, Cobalt, Red and his successor Rose. They capped over the passages which passed through them, and attached them into the walls of the rooms.[37]

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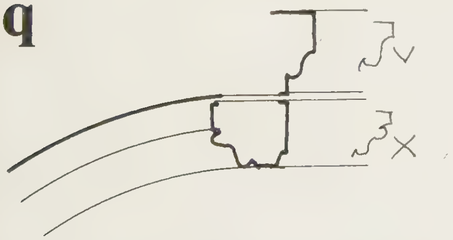
f. The boss in the ES is 1,460mm in diameter by Bronze-X since it has his corbel-shape on the underside, and he suits the order of the work **q**. As the EN clerestory plan was built before the ES, can we argue that the EN boss was by Ruby-W with the ribs?

q

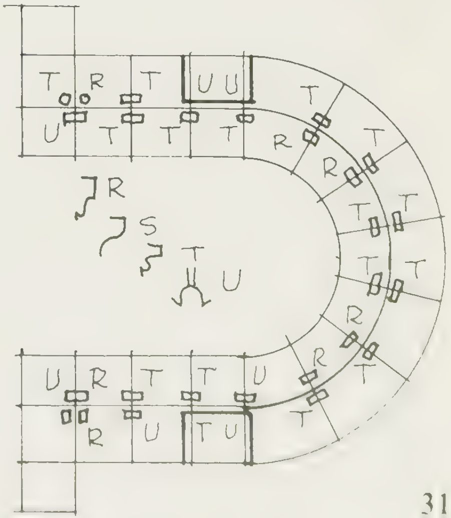


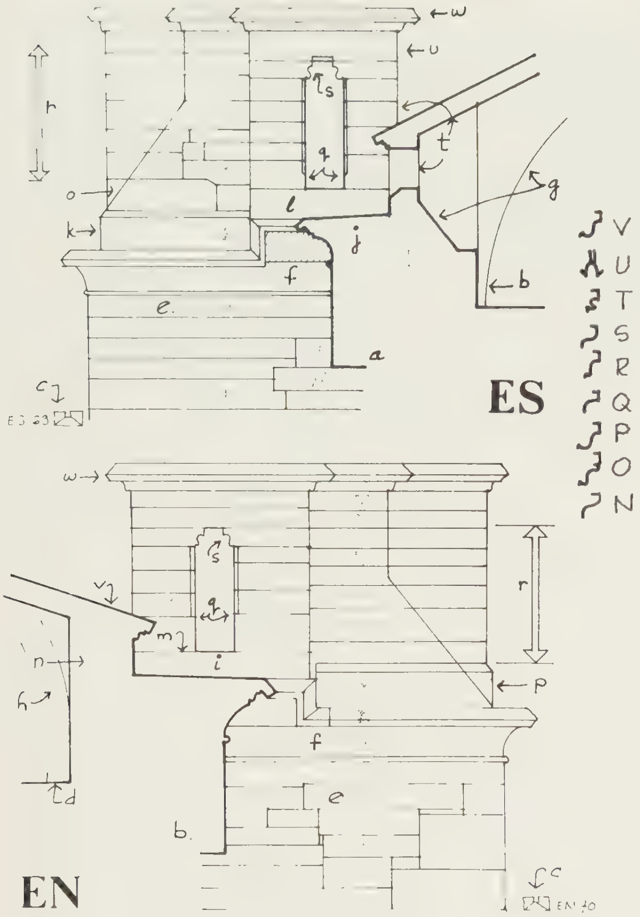
g. The external arches round the perimeter of the rooms project over the walls but the amount of the projection varies, for example, from 605mm on the north side of the ES room to 575mm on the south. This was done to square up the platform of the tower. See later.

h. Across the outer walls of these rooms there is a screen. Its bases are placed diagonally, with the corner of the block under the torus chamfered off. There are no archeological indications of who did them.

The north jamb of the ES-W door is wider than the south, and this difference is 'taken care of' in the lintel over the door. As the stair corbels show this lintel is by Red-T, and as can be seen in the projection flanking the screen, this is the topmost course laid in his campaign. The cornices in n.44 show that in the E.III buttresses Rose-U laid the four courses from his corbel to the underside of the cornice. He therefore carved the rest of the projections to at least the seating for the arches of the screen. The cornice lies over the face of these arches, and they are by Ruby-W. The capitals of the screen, small as they are, seem to be more Scarlet than Ruby or Rose. Hence, with some uncertainty, I would ascribe these curiously detailed and stilted arches to Scarlet-V, and because Rose carved similar bases to the NE.I spokes I very tentatively attribute these bases to Rose-U.

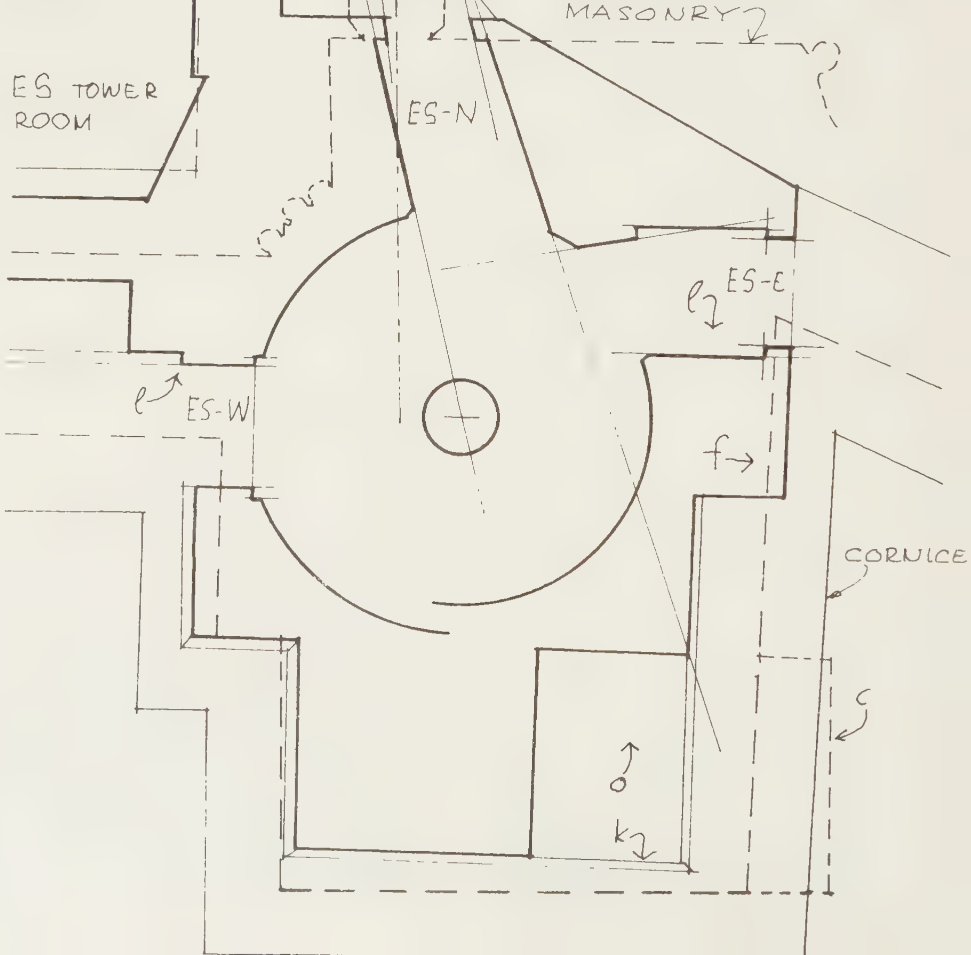
37. This is the arrangement of the corbels: some are unambiguously by Red, but a number are distorted as the passage is rather narrow. They could be squeezed variations of Rose, Ruby or Red. I made a tentative distribution from their shapes, and then noted the different ways in which they treated the underside of the lintel. Applied to n.43 they worked in nicely, so I accepted the order given in the drawing, in spite of the doubts.





Meanwhile the same crews were bringing up the stairs,[38] within which we find a new and important detail. In the rest of the building, almost without exception, the treads are taken directly into the wall without any frills or mouldings under them. But in both the apsidal stairs there is a group of treads supported on well-carved corbels.[39] As the corbel also follows the curve of the stair wall it is quite a difficult element to carve, being both bent around the wall and stepped up at each riser. There are a dozen of them in the southern stair, and fourteen in the north. The upper ones are cut from the same stone as one of the corbels over the doors. It is Red's, and you can see from the corbel Cobalt carved to one side of the ES-N door that his corbel was carved before Red did his.

Fortunately Red's program was a big one, for he built two meters in the stairs, and somewhat less in the adjoining rooms. He carved his corbel no less than 42 times, with enough stonework to give us a substantial holograph.[40] There is only one other staircase in the cathedral with treads supported like this: the north west at the level of the carved archivaults over the entrance door.[41] I will come back to this most important detail later when we come to discuss the delays to the north, but just note that he did not carve any other stair supports in



38. *Elevation of the two apsidal stairs taken from the east,* showing part of the rooms over the nearby chapels. These elevations are continued in n.43. On the plan of the ES stairs the outline of the buttress and wall below the walkway is dotted, showing how the geometry applied by one master at a lower level could be changed by a later master, with the wide overhang of the cornice disguising the transition. Notice how the faces of the buttress of the door jambs and reveals are seldom placed true to one another. Ruby's outer buttress is inclined to the inner one, but when Cobalt reduced its width he straightened the eastern face. Some of the angulations have been emphasised on the drawing by being extended with fine lines. Compare this plan with the changes made above the cornice in n.46.

COBALT-N, 1207

a. The arches over the chapel windows were built higher than the surrounding stairs as the joints in the buttress shows. As the windows are narrow the arches spring much higher up than those in the sanctuary, and they had to be pushed ahead if the eastern vault cells were not to be delayed. See XI:45 for joints, and the treads lower down.

BRONZE-O, 1208

b. On the north these window arches spring from carved heads which seem to be Bronze's - XI:24. If the cells were completed by the crew which built the arches, you can see why the innermost wall of the triforium rooms could have been started by the next - XII:11. On the south he began the arches around the rooms.

SCARLET-P, 1209

c. The position of his windows out of the stairs is marked on the side. He continued the larger coursing with the darkest shading on both drawings. Notice on the north how much higher his work was than on the south, which confirms the joint over the sill of ES.69 - X:44. He eliminated the eastern projection on the ES buttress, marked C on plan.

d. He finished at floor level, and perhaps slightly higher on some of these walls on the north - XII:11. Began the ribs - XII:35.

OLIVE-Q, 1210

e. Thin long stones, large joints, rough surfaces.

f. Cornices, including the change in level in the corner; and on the south he built the cornice without the coping over it - 'j'.

g. Continued the ribs of E.VIII and started the window with sloping sill as in the sacristy - VI:37.

h. Continued the ribs on the north side of E.I.

i. The threshold is a single stone with the EN tread. It continues under both the N and E doors. It ties in with Olive's drains -XII:41 - and the start of the west side of the northern door - XII:10/II.Neither Ruby nor Cobalt built any further treads on this side.

RUBY-R, 1211

j. Continues the cornice around the apse, including the infil over Olive's shown hatched, which was to support the projection planned for the buttress above it.

k. Plinth carved for a wide buttress - XII:10/II. Presumably for colonnettes as in the south - n.6.

l. The threshold and inside of both ES doors, and half of the north door. The south jamb of the ES-W door is smaller than the north. It is Olive's. This jamb is elevated in XII:42. Notice transition at lintel. Ruby reduced the diameter of the stairs from 2,370 to 2,080mm.

m. As the EN-E door jamb was set in from the threshold 5-6½mm, this locates the joint with Olive. Same door plan used on both sides.

n. The first course of the wall round the E.I room was built with or after the ribs, and because of 'g' is by Ruby. Confirms XII:42/h.

COBALT-S, 1212

o. He splayed the side of the buttress above Ruby's plinth to reduce it from a square one, to one with a narrower face more equal in width to those in the sanctuary. Compare with 'p'. The final buttress widths were taken in order from south to north.

II - 1,260 and 1,270
III - 1,568 and 1,595
IV - 1,370 and 1,410
apse - 990mm.

p. He reduced the EN buttress by beginning the splay from the bottom of the plinth.

q. The edge of the door jamb is splayed in the north from the second course, which shows the joint with Ruby. In the south the jambs with the splays are probably his, working to a lobby already set out by Ruby.

RED-T, 1213

r. Extent of corbels under treads marked by arrows - n.41.

s. Door corbels in the same stone as stair corbels.

t. The wall in front of the E.VIII room is butted into the earlier work of the buttress. This is the stone referred to in drawing XII:37. The roof over is partly butted, and so the next buttress is his too.

u. The lintel over ES-N door is by Red. It suits the arches in n.43. Others are by Rose.

ROSE-U, 1214

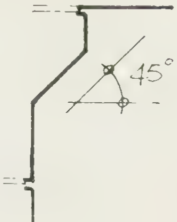
v. He probably began the roof on the north though the gable window is Scarlet - XII:38/III.

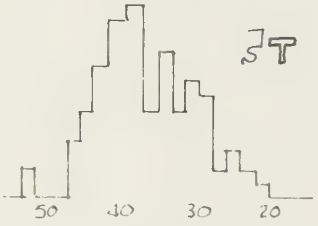
w. Cornices - n.44.

39. There is also a single support under tread SE.67 cut on a 1: √2 slope by either Rose or Bronze - perhaps to support an ill-cut tread? There is another under NE.30 cut on a 1:2 slope by?

41. Supporting treads 91-102 in the ES, treads 92-105 in the EN, and treads 52-59 in the NW stair - XV:15 and text.

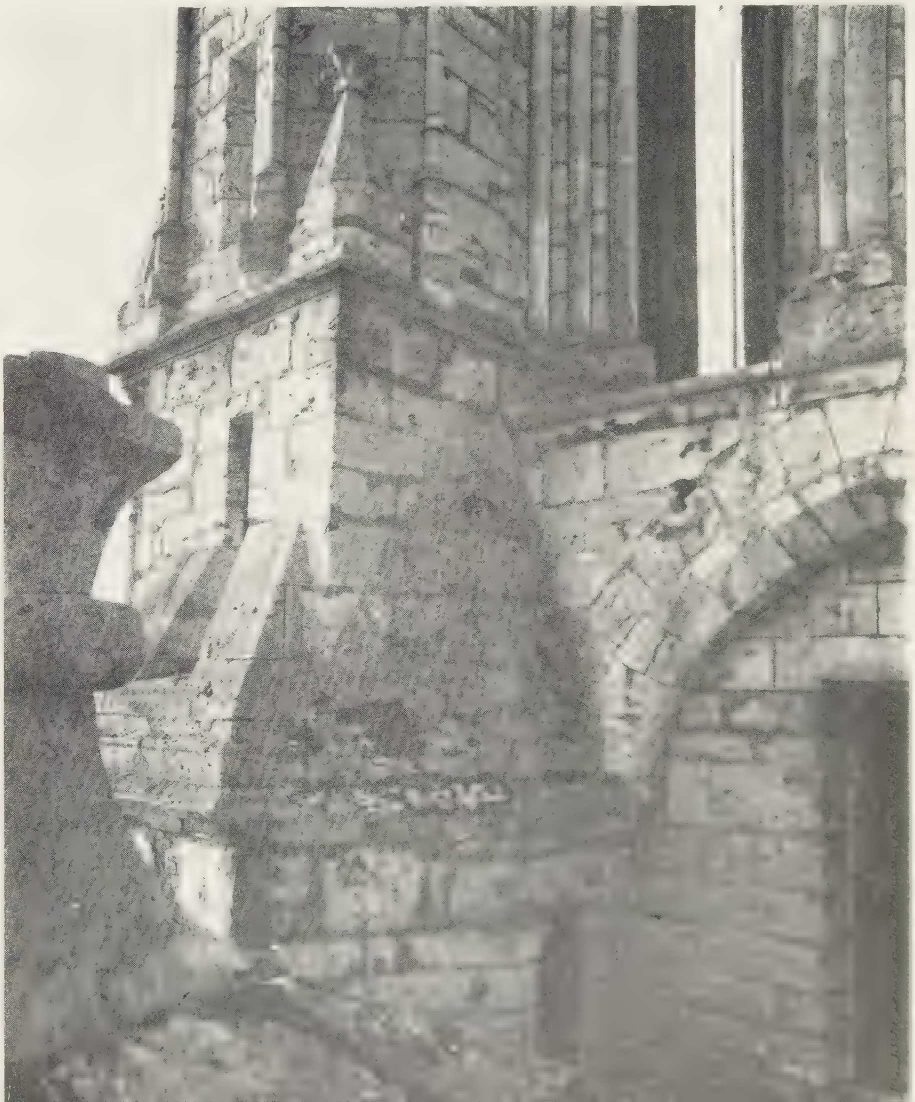
39.

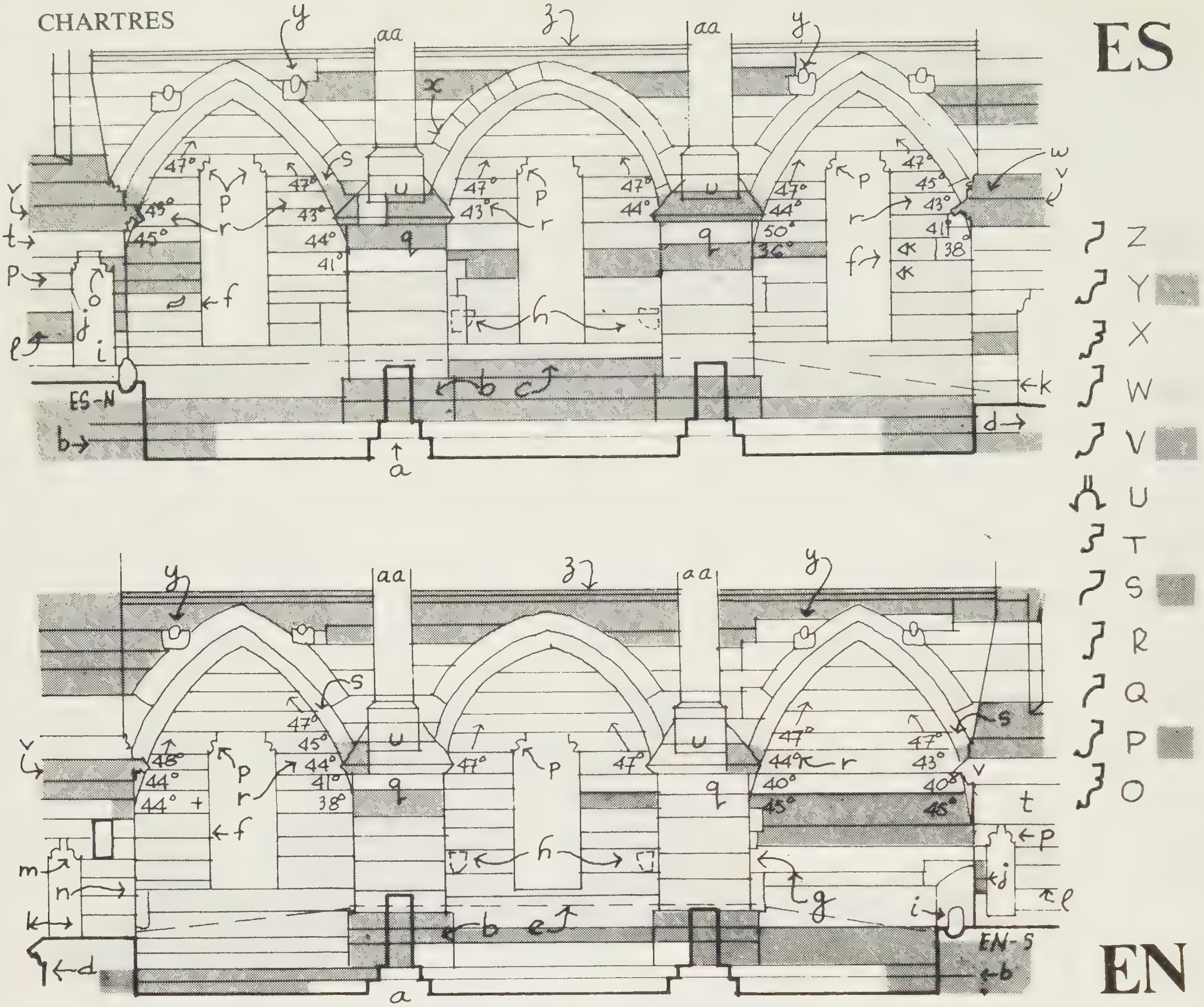




40.

PHOTO 317: The ES stairs showing the ES-N door with Cobalt's corbels, and the window on the right to the room under the tower. The large arch over this window was begun with Cobalt's corbel. See the drawings on the next page for the many joints here.





42. See section through SE room in n.3, and the sections through the nave and choir triforium in XVIII:30 & 49.

43. *Elevations of the three inner walls of the two apsidal towers.*

They have been 'unwrapped' in the drawing so that the innermost wall nearest the high altar is in the centre, and its two adjoining walls are on each side. The stairs are shown on the left of the ES drawing, and on the right of the EN. The elevations of these stairs may be continued in n.38 and 46, and the section is drawn in XVIII:30.

Work below the level of the arches:

BRONZE-O, 1208

a. Cross buttresses and base walls - XII and XIII:11.

SCARLET-P, 1209

b. Large octagons, different footings and some walling in rooms - XII.

c. ES drain - XII:41.

d. Perimeter cornice - XII:6, though the coping in the east is probably by Olive.

OLIVE-Q, 1210

e. EN drain - XII:41.

f. His walling is distinguished as lying over his thickened wall, between his vault corbels and his windows, and include his mason's marks - the latter are shown where significant. He used his corbel to support his thicker wall - GEOM:XIII-D and n.28.

g. His work drops below the level of the window sill on the north side of the EN room - n.36/a.

h. This is the level of the corbels under the vault ribs on the inside - n.36/c. Imposts n.18/e.

i. He placed an arched cover over his drains where they passed through the buttress - XII:42.

j. Began west wide of the EN-S and ES-N piers - XII:10 and n.38.

k. For the stones at the exit of the drains and for other joints in the buttresses see XII:42.

RUBY-R, 1211

l. For the east side of the big buttresses see n.38.

m. Inner corbels EN.III and over it the gable wall to the EN.III room - n.34.

n. Flat tops to drains - XII:42.

COBALT-S, 1212

o. Corbel on the room side of ES-N door - XII:42.

RED-T, 1213

p. Corbels over the room windows with vertical joints between the walls and the arches. Also corbels to ES-N and EN-S doors.

Work in the area of the arches:

q. The corbels over the octagons in n.37 have the circular stairs. The SW room had been sealed off, and there is no sign of his handiwork there between Cobalt and Rose in the SE. He did little in the nave, and even less to the walls over the choir triforium.[42] He seems to have concentrated all his attention on the areas which had lagged behind around the eastern and NW stairs, and around the choir. Considering the distribution of his work it is remarkable that he managed to finish so many corbels.

Around the eastern tower rooms Red carved some of the stones which cap the octagons under the flyers, and with them he began the arches which encase the tower rooms. These arches are weighty massive things, with a generous splay on the lower edge which begins just underneath the cornice. There are a number of changes in the size and the angle of these splays, and in the curves of the arches from which I could distinguish the work of five crews.[43] The first is the Cobalt who carved the corbel out of the ES-N door mentioned a moment ago, and the last was Bronze who came to the site in 1217. You can see how I am drawing on the teams identified and orderd in the southern rooms to sort out all these small changes in the east.

The cornices over the perimeter buttresses are like

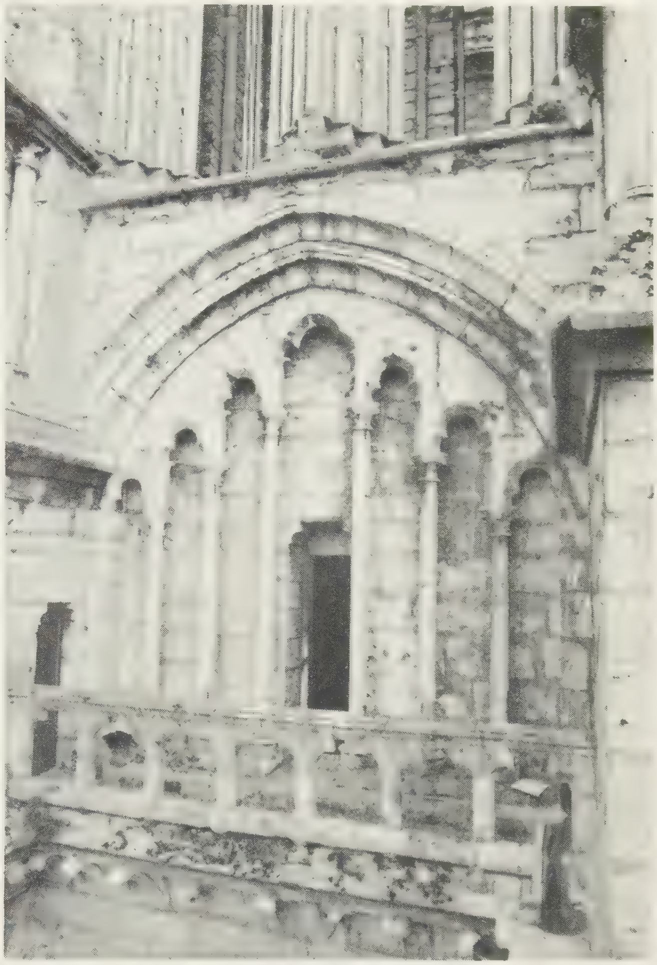


PHOTO 319: Scarlet's screen with Bronze's arch above it on the north face of the EN tower. See PHOTO: 264 for the ES screen.

helped to determine 'r'.

r. The splays on the corner of the arch voussoires vary in size and angle, and the latter characteristics seem to be more indicative of the master and are marked alongside each course in the drawing.

Cobalt uses 37°; Red 41°; Scarlet 43-5°; and Ruby 47-8°. The first four concentrated on the few courses around the copings over the octagons, leaving the bulk of the work to Ruby. As some stones have been replaced there is some uncertainty - n.46/j.

s. The radius of the arch changes from what was implied in the bottom stones to what was built above, presumably when the formwork was set up. The changes occur most obviously in ES-E right, EN-W left and EN-E left.

t. The arch stones at ES-E left and EN-E right are clearly the work of Red as they are joined to his corbels and treads.

u. There are obvious variations to some of the copings over the octagons, especially on the eastern sides of ES and EN.

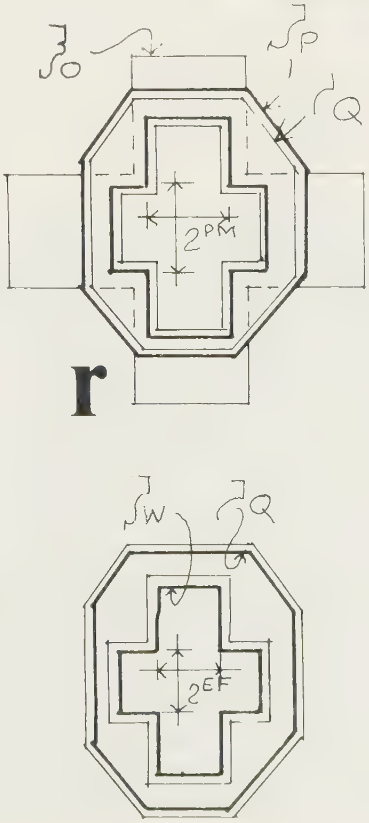
v. The variations in the cornices over the buttresses are discussed in n.44.

w. The moulding over the cornices are all the same, but the idea was begun in one of the arch stones by Ruby, the ES-W right. This one is smaller and is set lower. Hence the others are by Scarlet.

x. One ES upper arch stone is larger than that at the springing showing the joint.

y. The spouts over the arches are by Bronze. It was typical of him to drain his roof this way - n.57. Note the drip under their leading edges.

z. For the copings over the room and the design of the towers see XIV.



r

aa. The reduction of the octagon to another Greek cross seems to have been the work of Scarlet in the ES, showing what he must have had in mind when he first changed Bronze's cross into an octagon six years before. His shapes shown at the top of **r**. They were further reduced by Ruby, shown at the bottom along with the reduction Olive made to Scarlet's octagon - GEOM:XII-E & F. Notice here Scarlet's massive design, heavier than most of the other masters, and his intention to build the flyer arch 2^{PM} wide as in the nave. Ruby reduced this size to 2^{EF}. This shows that even at this late stage the flyers in the choir could have been built to the same dimensions as those in the nave, except for the width of the buttress over the walls. The modifications made above this point are more decorative than real, being in the spokes and in the arches over them.

those in the nave and amongst them I could easily identify the heavy style of Scarlet.[44] So the same hand must have carved those in the nave just underneath the ostiums, which links the ends of the cathedral to one another in a most important zone.[45] It shows that Scarlet must have been responsible for designing the ostiums, and may have even have done some of those badly worn statues resting under the feet of the bishops above them. Would he have used the same recesses within the buttresses of the choir? Though he laid a number of the cornice stones just below the columns of the aedicules which were built there, his work stopped below where the ostiums would have been.[46] On the northern side of the choir the aedicules were begun with two columns set into a recess in the wall of the stairs, while in ES.IV the columns were framed in a moulding. In the north they are *en delit* and in the south engaged. And indeed, not only are the details handled differently, but so is the layout of columns and the way they are related to the mass of their buttresses. I think one is the work of Ruby-W, and the other of Bronze-X in the next year: the bases and details seem to suit their respective dossiers.[47] The other shafts in the aedicules were stood up gradually until in 1220 Bronze and Olive began to roof over them.

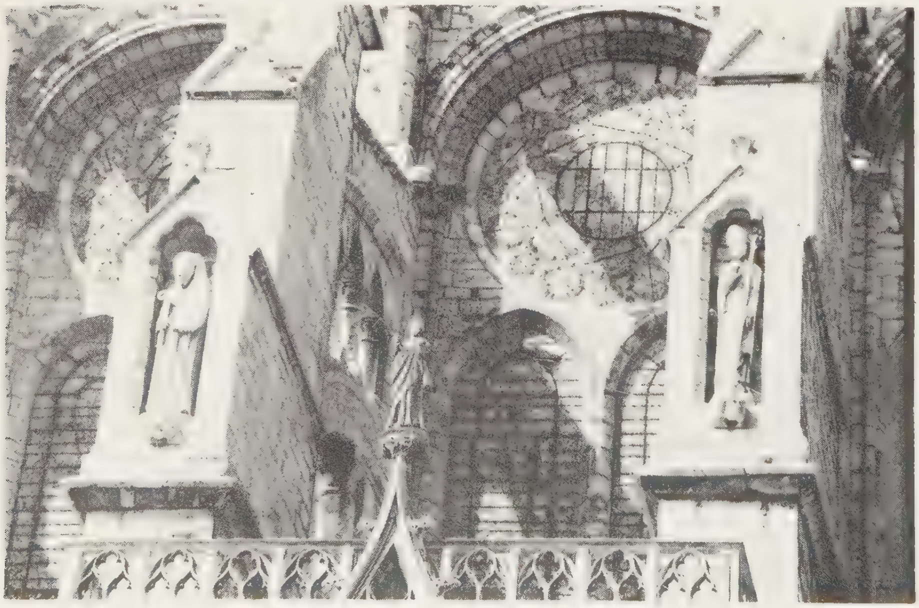
If the colonnette-encased buttress was Ruby's idea in 1206 or 1211, how right that he should wish to continue the concept by building aedicules rather than ostiums, and these little temples show how Ruby may have finished off the top of the colonnettes at the top of the flyer buttresses. I can imagine him arriving on the site and finding Scarlet's ostiums in the nave, feeling antagonistic to them, and making changes in the east. The ostiums hollowed out the solid of the buttress, which like a cave emphasises the mass of the stonework. Ruby's approach as the opposite to this, for he would have hidden the solid mass behind a screen to disguise it. Both masters wished to modify the mass, but where Scarlet burrowed into it, Ruby fenced it off.

The ones in the sanctuary have a large shaft in the centre with a base set diagonally to the buttress. The bases of the small shafts which surround it are set square, so that the corners of the large base point between them. It is very like the arrangement of the piers under the north porch, and I shall return to this later. Though it is beginning to take us too high in the work for this chapter, just notice in the footnote the many anomolies among the aedicules, particularly the use of a circular shaft on the north where the torus, and the pattern of the shafts on the ground floor, would have required a circular one.

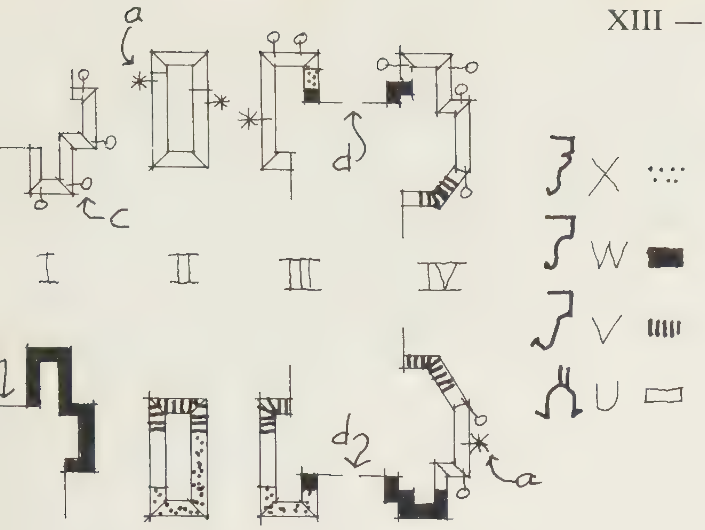
These aedicules have proved to be a remarkably successful device. The buttresses they cap vary greatly in width, yet these little temples have managed to bring them together. Their open form and sharply pointed roofs gather our attention to them rather than to any of the diverse elements roundabout. We are more aware of their unity as a group than of the confusion around them, for our eye tends to skip horizontally from one to the other. Their decorativeness overides all other elements. Small as they are, the aedicules are the most compelling decorative motif round the choir.

If they had used the simpler forms of the ostium instead of the aedicule, the differences between the buttresses would have been emphasised rather than muffled. On the other hand if aedicules had been used in the nave that end would have looked less massive and the two arms of the cathedral would have had more in common. I would be surprised if Scarlet had not intended to repeat the ostium form in the choir - and though the position of the joints show that he did not get the opportunity, it was a close thing.

Once again we can see how the accumulation of changes made in the east had so altered the character of the work that the masters were strongly tempted to treat the choir as a separate entity. Though each end of the



PHOTOS 320 & 321: On the left the ostiums of the nave, and on the right the aedicules of the choir. One was begun by Scarlet at the same time as he was carving the springing caps for the nave vaults. The other was detailed by Ruby in the course over the cornice Scarlet had placed to match his in the west, presumably for a similar arrangement of ostiums, rather than aedicules.



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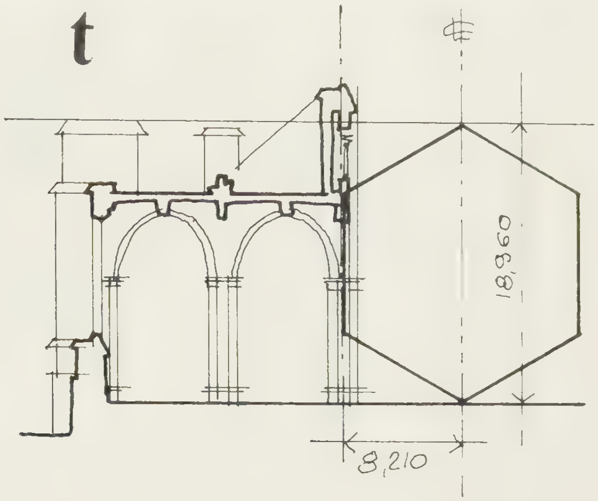


44. There are enough variations in the shape of the cornices over the triforium walkway to isolate four teams. The major differences are in the length of the drip marked D in **s**, as in the sactuary aisle cornices. The work of Bronze measures 240mm, Rose's measures 180-195mm, Ruby's is 205-225 and Scarlet's 210-220mm. These dimensions are consistent with the work by each of these teams elsewhere - X:12 & XVIII:10. Other indications are:

a. Rose's often have tumours which are marked with an asterisk - XVIII:8. Most of his seem to have been cut but not placed, for at the corners they have been altered so that the original return under the drip (marked U in **s**) penetrates through to the new drip face. This shows he had cut them in long lengths, and that they were recut at some other time for the corner positions. I have assumed that they were all placed by his successors Scarlet and Ruby, except EN.I. For the geometry see XVIII:7.

b. SE.I has the upward sloping section described in n.17/h.

c. Over EN.I many old Rose cornices were recut, but this time by Bronze in 1225 - XVII:14/r and 36.

d. The arches over the south face of the ES tower room and over the north face of the EN, shown in PHOTO:319 are made of two rows of Bronze corbels. You can see the starters for some of these in the Ruby cornices, but the final form of the arch was not established until 1217 - n.48.

See n.45. He fixed the spring of the main vaults within a pentagon figure - and like them he established the cornice heights from the main floor as an expression of the wall centres, rather than the flyers. He took span of the nave, and formed a hexagon to position the cornices **t**. This is the situation on the southern side of the sanctuary, but on the north the cornices are 100mm lower. The height is precisely equal to the distance of the nave buttresses at 17,780mm. Was one of these taken by Red in laying the underside of the cornice shown to the right of the EN tower in n.43.

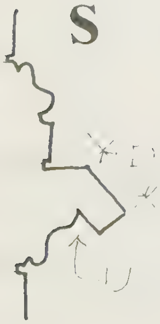
e. The apse follows a similar pattern to ES.II. The heights were set first in the north sanctuary, probably by Red-T in laying the courses up to the underside of the cornice, shown in n.43. At 18,850 to the top of the cornice he may have determined this as 8/3 the bay. As a 'new boy' to the job a relatively easy decision like this would have been natural.

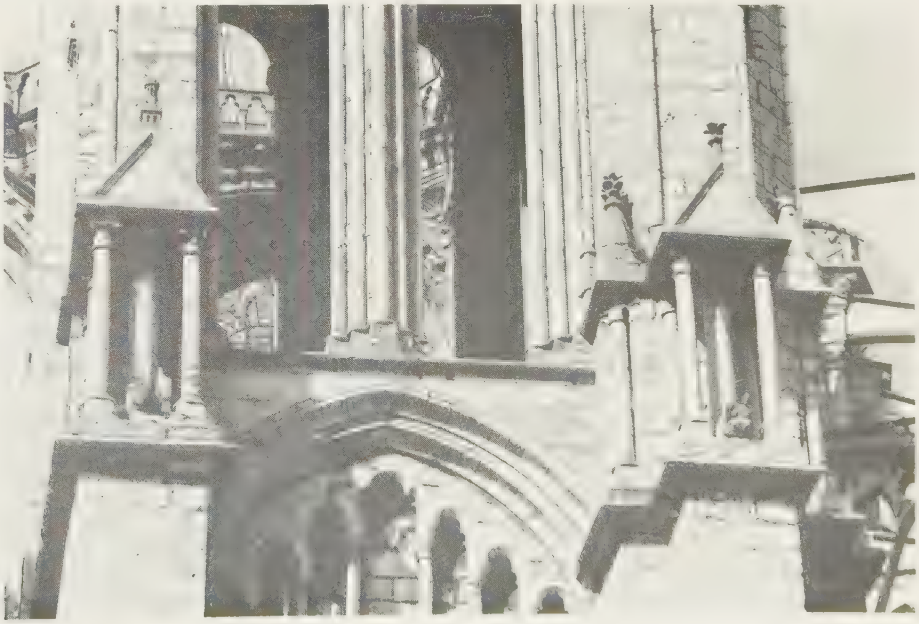
On the south Rose-U was stuck with the courses already put in by Red, but managed to lower the cornice 100mm, so that the top was in line with the top of the course above that in the nave where he had been able to control the heights more completely. There he used the approximation for $\sqrt{2}:\sqrt{3}$ as 14:17 described in GEOM:XVIII-E. This was also equal to the distance from the nave buttress epicentre to the middle of the building, forming a neat square in section. Scarlet-V completed much of the choir and all the nave, using Rose's base level, but his own taller coursing, to the hexagon shown in **t**, taken to the top of the cornice in the sanctuary, and to the top of the second moulding in the nave, the top of the cornice was then 80^{RF} to the crypt - n.45. See the consequences of the different heights in nave and choir on the north facade in XVII:36.

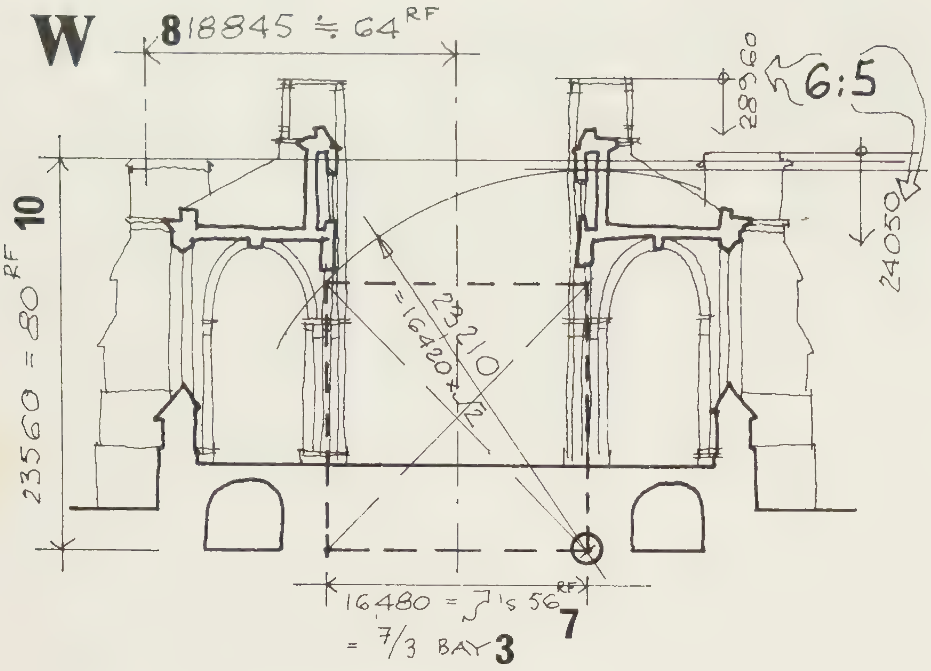
45. The section through the nave ostium cornices is identical to the one Scarlet used in n.44, and is very similar to the ones he carved around the sanctuary in 1200 and his clerestory walkway - VI:56, XVIII:10. The geometry follows the system he used in his corbels -GEOM:II-A, though it is slightly different to

46. & 47. SEE NEXT PAGE.

S







his earlier cornices. Draw I^{PM} vertically and divide it into fifths in **u**. From this point draw the circle which passes over the top of the cornice, unlike VI:56, and from where it cuts the top draw the drip splay. The splay and the height of drip are thus equal. Form the projection of the moulding as the diamond around that circle. In **v**, fix the depth of the drip as shown from a quarter of the PM, and then draw in the undermoulding to suit.

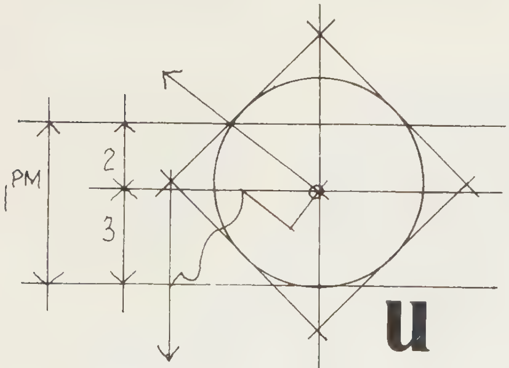
Scarlet set his cornice 500mm lower than Rose's in n.44. He began with the width of the buttress epicentres, which average 18,920mm from the centre. I think he saw that this was only slightly more than 64′ (18,845mm), and that a quarter added to that gave him 80′(already used in the diagonals of the 113′diamonds in the Creation Figure — VIII:58). So he set the cornice 80′ above the crypt floor as he had worked to the crypt floor in IX:6 (23,560 = 5,100 + 18,460). It is also twice the height of the arcade caps (9,230 x 2 = 18,460). This gave him a series of simple relationships shown on the left of the section **w**.

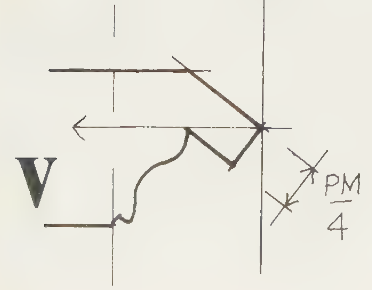
There are other relationships on the right: the span formed into a square gives a diagonal which positions the underside of the cornice, and the top of the moulding over the cornice from which the flyer arch rises was made his favourite 5:6 below the springing line which Rose had already established in the previous campaign - see GEOM:XVIII-E.

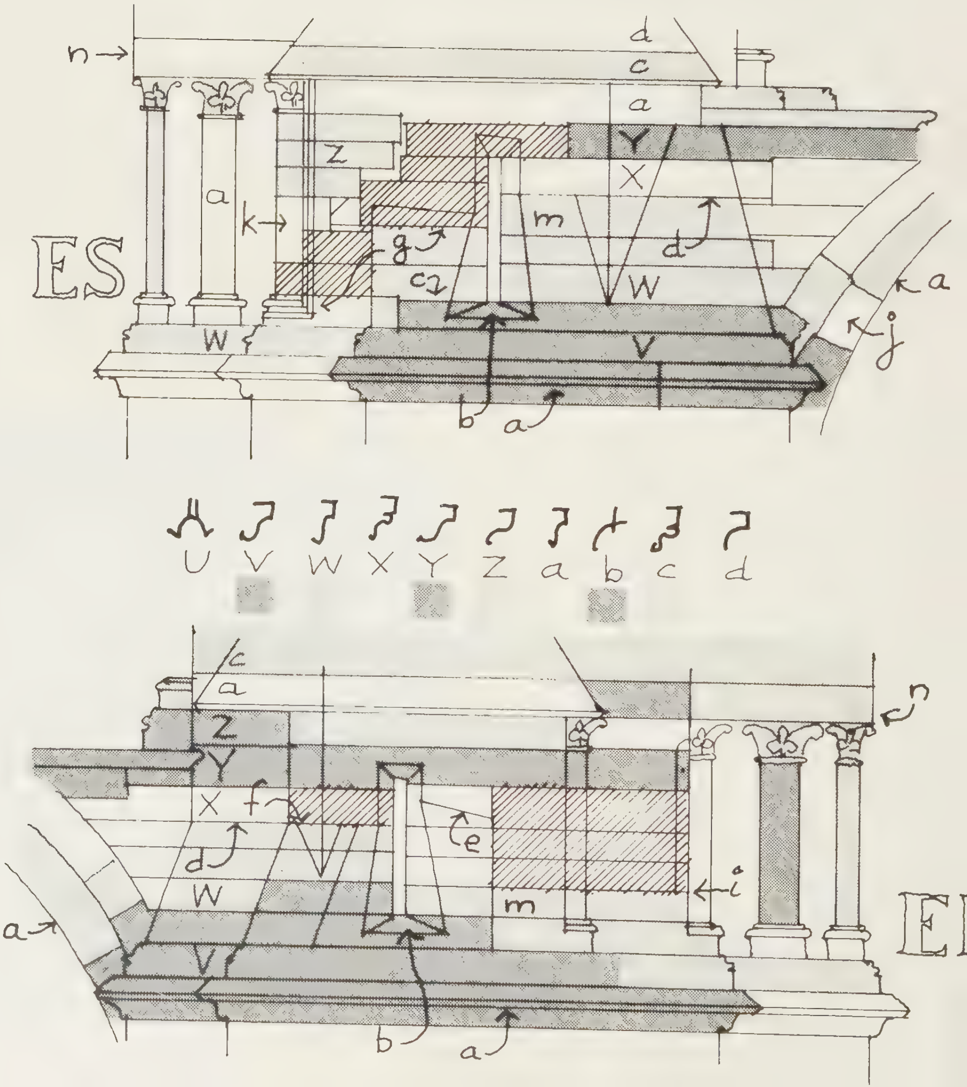
46. *The elevation of the E.IV buttresses from the east.* This is a continuation of the drawings in n.38. Starting from the now secure attributions in the tower rooms and their cornices, and from the beginning of the towers to be described in the next chapter. I analysed the joints between these points and allocated them like this:

SCARLET-V, 1215

a. Cornices from n.44, and the continuation into the room arches in n.43.







b. ES.104 window looks very like Scarlet's SW.64, but as the outside face of the wall slopes inwards, as can be seen in the plans and as I do not know where he intended to place the end of the slope, I cannot analyse his geometry. On the inside it has the same $\sqrt{2}:\sqrt{3}$ ratio used elsewhere. Hence, in campaign 'V' he began the sill with the moulding underneath and the cornice next to the arch. From this it is clear he was responsible for recutting Rose's cornice - n.44/a. The EN.108 window follows the same pattern.

c. The step in the coursing shows where the joint is.

RUBY-W, 1216

d. He continued the slopes Scarlet had begun, finishing with a horizontal crease against the vertical section of the wall above the splay.

BRONZE-X, 1217

e. On the north side of the EN there is a join where the slope is increased and it meets the vertical section of the wall in an inclined crease, not a horizontal one.

f. On the other side of the EN window Bronze began his work where the angle of the wall over the slope is changed, and this shows that Ruby set out this aedicule.

g. On the south side of the ES there is a similar alteration to the slope showing where the join with Bronze occurs. The base of the shaft of the ES corner is Bronze, for the plan shows it is framed like his in the north porch - III:39. On the west this moulding lines up with Bronze's arches over the south face of the room.

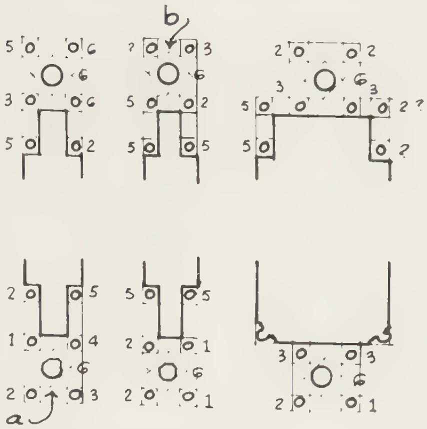
h. Many Bronze stones are yellower than the surrounding ones, showing they were cut from a different part of the quarry. These stones are shown hatched. He used the same quarry face later - XVII:15/w. Perhaps the reason that each crew did their own quarrying was that Chartres may not have had a permanent lodge of masons. There are a few stone buildings from this period in the region. The cathedral of St. Pierre and a few houses in the town are made of stone. In other areas the peripatetic building crew may have just laid the stones the more permanent quarrymen had brought from the quarry (Southwell Minster is one example). Therefore the differences in stone sizes and cutting techniques which here are such a useful indication of identity may not apply to the same extent in other areas. This needs further study. See Salzman p.187.

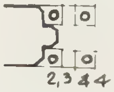
i. The underside of the yellow stones in EN lines up with a change by the corner column where the edge has been splayed, which is as much as he could do on this side to match his moulding in the south.

j. The two replaced stones in the ES arch are left shaded, but from the order they would be by Ruby along with the beginning of the second arch. Similarly in EN - n.43.

k. All these column stones are engaged at each course, except for a short length *en delit* that looks like a modern replacement.

l. The diameter of the staircase was reduced from 2,080 to 1,940mm around the middle of the window. Was this from Ruby's 20 palms to Scarlet's 20?





m. These joints are confirmed inside the stairs where the coursing is stepped. The lower work is by Scarlet and Ruby, and is better finished than the later work by Bronze.

n. For the aedicule roofs and the continuation of their cornices into the towers see n.47 and XIV:14, 20 & 29.

47. In the sanctuary the aedicules have four shafts surrounding a larger central one. There are two smaller shafts set back into the buttress, extending its arcading inwards, except around the ES where Bronze had begun another solution. In the apse there are only four shafts as the buttress was not wide enough to accommodate a central one. This is a good example of a form established early, and then repeated with variations by a number of later masters. These shafts complete a pattern around a buttress shaped like the suggested nave buttress in n.6.

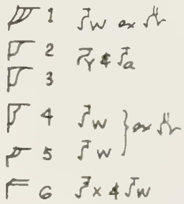
a. In the south the larger central shafts alternate - circular and octagonal - and they match the alternations inside the building. They are the work of Bronze-X from their torus moulds, though Ruby-W is a possibility which I rejected as he failed to continue these alternations in the north transept - XVII:36. The ES.II shaft is circular on the outer face, but the inner part has a number of facets as if it was to have been octagonal!? The placement of the bases for these shafts at 45° to the surrounding ones is the same as Bronze-N used in the north porch piers, though as I said in III:39 and GEOM:III-E the idea could have been initiated by Ruby a little earlier. This problem cannot be resolved in the aedicules as either team could have been responsible - we need a detailed study of another cathedral.

b. In the north the bases alternate as in the south, but the shafts over them are all round. Seems to have been the work of Cobalt or even of the new team Jade.

c. From the arrangement in the cornices and from n.6/b the layout of the sanctuary buttress aedicules must be by Ruby-W - n.44. See the similar ones in the north transept which are definitely Ruby - XVII:36.

d. This is confirmed in variations to the corners of the bases **x** where types 1 to 5 could have been by the gang which Ruby had taken over from Rose. As the bases carved by Bronze and Scarlet in the clerestory are so like their earlier ones, I felt I could only give these ones to Ruby or to Cobalt. From the order of the flyer arches which are supported on them it must start with Ruby as the bases closest to the choir are built in with the buttress. From this I argued that Ruby must have changed the style of his bases from those he carved lower down. This solved the problem I had had with the one rogue base in the choir triforium - XII:32/II.e. The other bases may be the work of Cobalt-Z, and in the north perhaps Ruby-a and Jade-b.

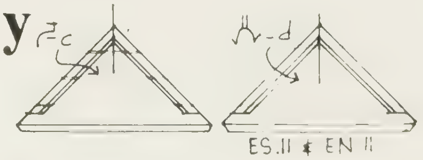
X



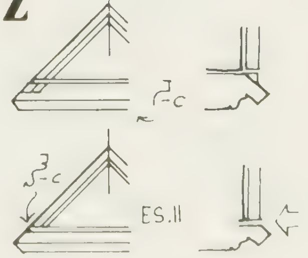
e. Most of the capitals are the work of Ruby-*Eyes* and *Pawn*. Some are by Bronze-c, though EN.IV may be Cobalt-*Noblik*.

f. All the stones in the gables themselves are arranged in the same way, with a lintel course and three equal courses over **y**, except ES.II and EN.II where the two central courses are joined into one. The lintel of ES.II is thinner than the others, and finishes differently against the next course **z**. Similarly on the north the lowest course gives no sign that a gable was intended, but probably a sloping hip. I gave this stone to Bronze with the capitals underneath because he had used hips round the EN(cw) - XIV:14. The gables over the north transept aedicules are begun in exactly the same way, also by Bronze in 1230 - XX:28. The single stone I gave to his successor Olive, and the next to Rose with the pinnacles - XII:38/V.g.

y



z



building had been begun by the one hand, every modification took the choir further and further from the nave. The more it was altered, the more difficult it was for them to use the ideas begun in one end for the other. By the time the cathedral had advanced to this level the two parts had evolved along such different paths that they might have been separate buildings. The ostiums and the aedicules, successful as they are in their context, are only tokens of this separation.

Now we can see how many teams could be involved in each level it is possible to understand why the architecture of this period is so varied, and so rich in detail and motifs. From the Bronze who laid the first footings under the eastern rooms in 1208 to his return to lay the arches surrounding them is ten long years.[48] Ten years to build little more than five meters. Is it any wonder that this zone appears so complicated?

If it was not for the evidence from the southern transepts, and the later clues in the north I would not have been able to fix half of these things without being restrained by a tedious uncertainty. In some places a team had built so little that if it was not for the broken coursing, the butted and mis-matched stones, the different surfaces and changes in detail, it would be hard to credit their presence. Look how many explanatory footnotes it has produced - more than most other chapters. In writing this I am reminded of the words of Steven Runciman that a historical canvas is necessarily crowded with characters, and readers who are afraid of crowds should keep to the better ordered lanes of fiction.[49]

So, having followed the construction of the eastern towers up to their vaults, it is now time to return to the south where the roof over the rooms was being pulled down, and work was moving ahead once more. The first sizeable program after Olive's in 1210 was Bronze's in 1217. Window 93 in the SW stair is characteristically his, with parallel sides.[50] By following courses through the

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[48] These are the arches with the two rows of Bronze-like mouldings in them - n.44/d. The screen underneath which may be seen in PHOTO:264 begins with bases set at 45° on top of the plinth. The arches begin alongside a change in the corner of the wall and the buttresses above Red's corbels. This change is after Red and before or with the Ruby cornice. I am inclined to place it with Scarlet, for the small capitals have simple leaves and crockets, drilled, like some of his in the triforium arcade, though affinities with SW.I rose caps suggests Rose. The use of trefoil round arches suggests Ruby, so?

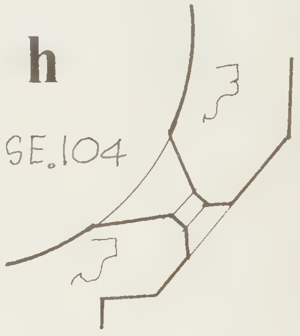
[49] Steven Runciman, Sicilian Vespers, Cambridge, 1958, p.xii.

[50] This sill is uncharacteristic in not having upstands for the jambs. In later windows the upstands were reintroduced. The geometry, as in SE.65 in GEOM:IV-H, begins with the diagonal from the corner of the buttress B. It is the diagonal set at 45° to the south walls, shown in **e**. The midpoint of the geometry begins where this line is cut by the one which joins the newell N to the corner of the square which frames the buttress P. Around this intersection C form the width UCV equal to one third to the stairwell. Form the right construction line VX square to the diagonal from B, and form the left UW square to the outside wall. Thus a disharmony has been set into the window.

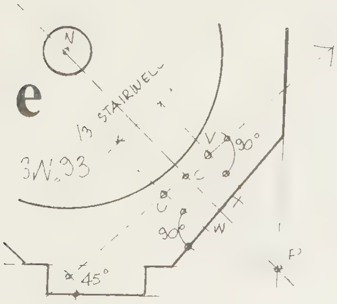
In **f** form a 45° triangle around W and X true to the wall, and at its apex form a circle of one quarter of the wall thickness. Form the right side of the window slot parallel to the left construction line in **e**, and similarly form the left parallel to the right. Opposites are related, and the disharmony has been stabilised. Now in **g** form the inside construction line parallel to the diagonal from B, and extend YU and ZV towards the stairs to form the inside faces. As with SE.65, we can say that the geometry is expressed in the corners of the windows, not in its planes. He produced an almost identical window further up in this stair showing he was still following the same ideas. There are others in the EN stair - XIV:13.

In the SE stair the 104 window is wider and fuller, yet the inside splays are very like SW.93. Just below it is a Bronze corbel over the top of the SW.III-S door. I think that Bronze began this window on the right, and that his successor Scarlet finished it by designing his version of the opposite jamb on the left. This was easy for him to do as the sill was a flat one without any indication of where the other jamb was to be placed **h**. Bronze also began the window out of the SW.III room looking south **i**, with its steps leading up to the sill. It is placed centrally to the external space between the tower buttresses and it suits the positions of the colonnettes. The sides of the slot have been mutilated - n.24/e.

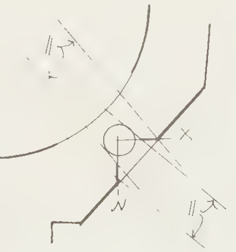
h



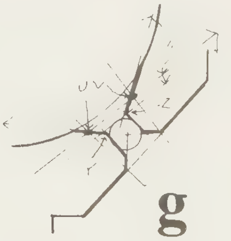
e



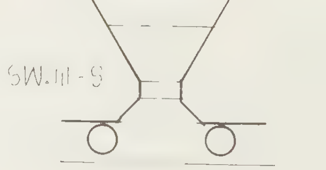
f



g



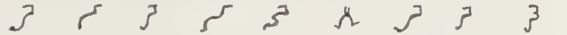
i



stairs it can be seen that it would have been built with the corbels he placed over the doors onto the triforium passage. This seems to be the right place to draw the section through this part of the stairs, for though confused, it supplied enough of the missing clues to allow me to extract the correct order here.[51]

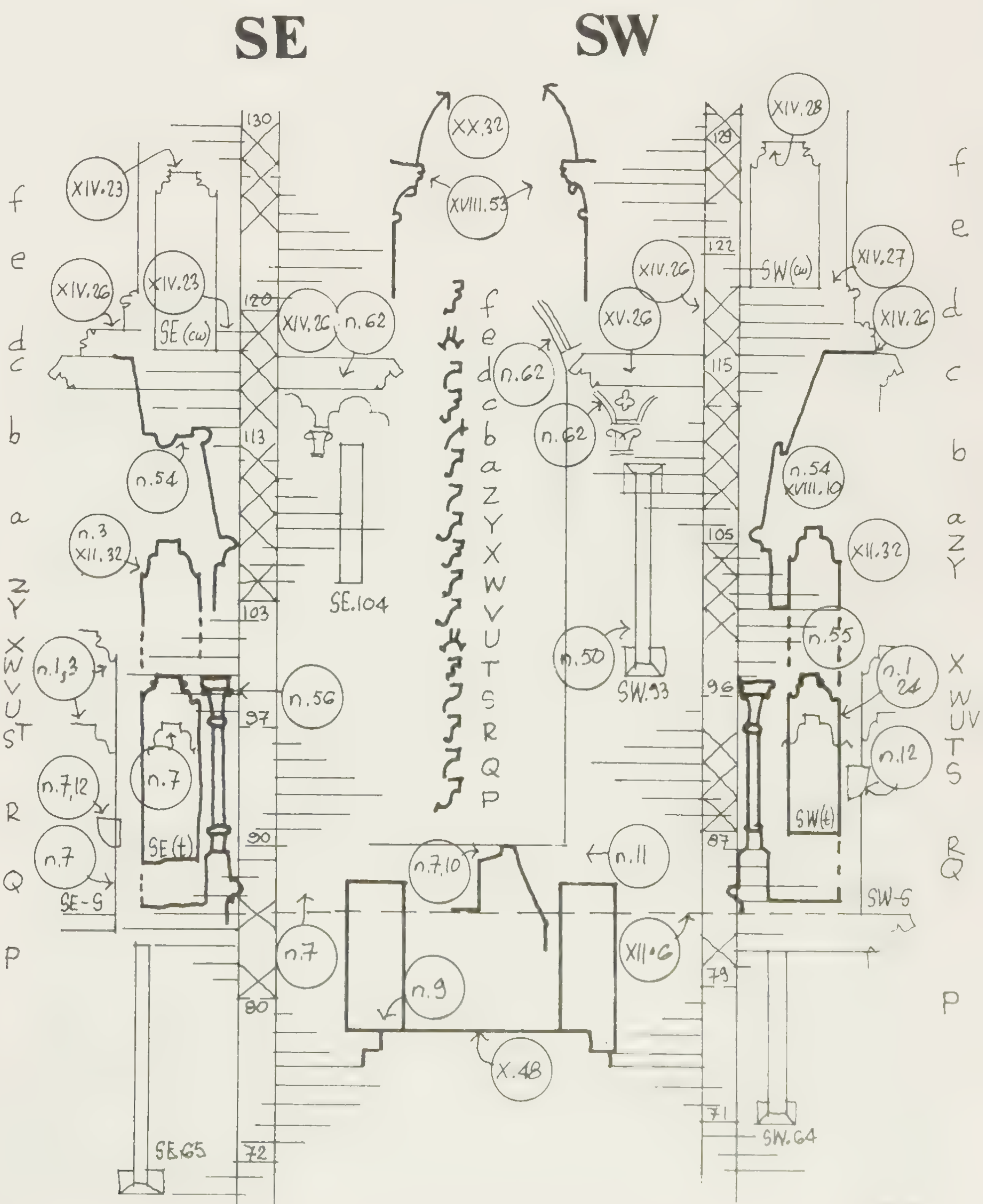
Probably the simplest way to summarise the evidence for the crews gained from this area is by a chart.[52] I have listed each campaign from 1209 to 1217 and where the identity of a crew is unmistakable from a corbel, a window or some other characteristic detail I have used a bold type, and where I am less certain I have used a lighter type. From the chart you will see that the work of most of the masters is gratifyingly distributed right across the building.

With such a miscellany of designers it would be surprising if the vaults over the two southern rooms had many points in common. I have already shown that Scarlet set out one room, and Olive the other using different types of pilasters for their ribs. Nevertheless the rooms are about the same size, and the vaults spring from much the same height. This is why I would have expected the two vaults to be similar. Yet the western one rises much higher, its boss is thicker and bigger, and was finished with square edges instead of curves.[53] The western ribs are pointed in section, while the eastern ones are heavier and flatter. Though both sets of ribs seem to follow semi-circular curves, the cells of the western ones are pointed, while those in the east are rounded. This is what pushed up the roof over the west, which is steeply



52.	1209	1210	1211	1212	1213	1214	1215	1216	1217
CORBELS	E	S, E	SW, SE	SE, E	SE.E	SE, E	SW	SW, SE	S.E
DOORS	SW, E	S, E	E	E	SW. E				
WINDOWS		E	SE	SE	E		E	SW	SW.SE
DETAILS	SE	S, E		E	E	SE	E		E

51. *Diagrammatic section through southern stairs.*
This section continues from where X:48 left off, and is continued later in XX:32. Notice how double treads are beginning to be used in profusion, starting with Olive in 1209. The only masters to use them here are Olive, Bronze, Jade and Cobalt. Ruby, Scarlet and Rose do not seem to use them at all. The references to these notes on which this drawing is based are marked in the drawing.



52. The teams dug out of the northern towers are not included in this list, for I have used this order as the basis for assessing that in the north, and so this section must stand on its own feet.

53. 350mm higher. This is not explained by different sizes of the rooms, even though one diagonal in the SW is 200mm longer than that in the SE. The bosses may be Cobalt-Z, and Ruby-a. See similar bosses to those in the SE in the northern rooms, and these could be Ruby too - XVI:14/x.

pitched and falls to a gutter let into the stones of the roof. This gutter continues all round the perimeter of the roof, and discharges through the wall over two projecting spouts which rest on large Bronze corbels. In contrast the eastern roof is almost flat, and falls uniformly to the inside without integral gutters.

Enough changes? Well, we still have not finished. There is another gutter between the roofs and the clerestory windows, which is scooped out in an elliptical section in the west, but forms a half circle in the east. The western one lies close to the edge of the roof as far from the glass as possible while the other snakes around the projecting mullions and buttresses so that at all times it remains in the centre of the visible part of the stone.[54] From the pilasters under the vault ribs to the drains over the roof there is not one thing in one vault which matches the other.

I must say that few people have bothered to observe these building technicalities before, but I have found in my work as an architect that this is just where the work of one man differs from another. It is our handwriting, and I can see in the work of my contemporaries the same personal quirks being repeated again and again from one job to another simply because they have been proved useful, and can be employed in almost any design. They are seldom the more obvious items like windows or entrances, but are the minor things which are unimportant visually, yet so essential technically that they are likely to remain constant items of the master's repertoire.

On the inside of the rooms the vaults are supported on the wall over the interior triforium passage, showing that this had to be completed before the cells could be started. The joints in the arches over the arcade shafts can be clearly seen in these end bays, for the ubiquitous layer of plaster which covers most of the inside of the building, blunting its fine details and collecting a dismal patina of dust and cobwebs, has here been left out.[55] These end

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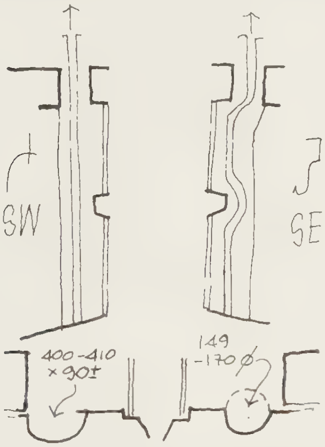
54. The SE gutter is Ruby with Jade's roof over this - n.3 - the SW is Jade with SW:II buttress, and the roof by Bronze. The reasons for placing these joints work out from XIV:26/i. Compare with the north (cw) gutters in XX:28/f.



55. Italian contractors were employed to coat the interior of the building with a plaster wash. It was a popular technique at the time for cleaning up churches and lightening the interior. They were paid in 1771, though a number of people have scribbled their names into the plaster before this! The earliest in an appropriate script is dated 1769 (EN.III). In the 1930's the plaster was removed from the end bays of the transepts so that the state of the stonework could be examined. Contemporary with this plaster-work the stained glass must have been re-leaded, for on the east lancet of the south transept one pane of glass has scratched on it the name of the glazier who repaired the work, Boulay, with the same date of 1769.

56. The bases of the columns in the triforium arcade are Rose from their splayed bases - XII:32/II. Some of the capitals are his too, being like those in the neighbouring choir bays - XII:32/III. The others would be Scarlet-V.

a. Arches formed of three stones, except for the first in the SW. Joint at R where there is a sharp bend in the curve of the arch. The other change at S just seems to be where the two outlines have been reconciled. The eastern arches are set 30mm higher than those in the earlier bays, rising to 55mm higher in the south.

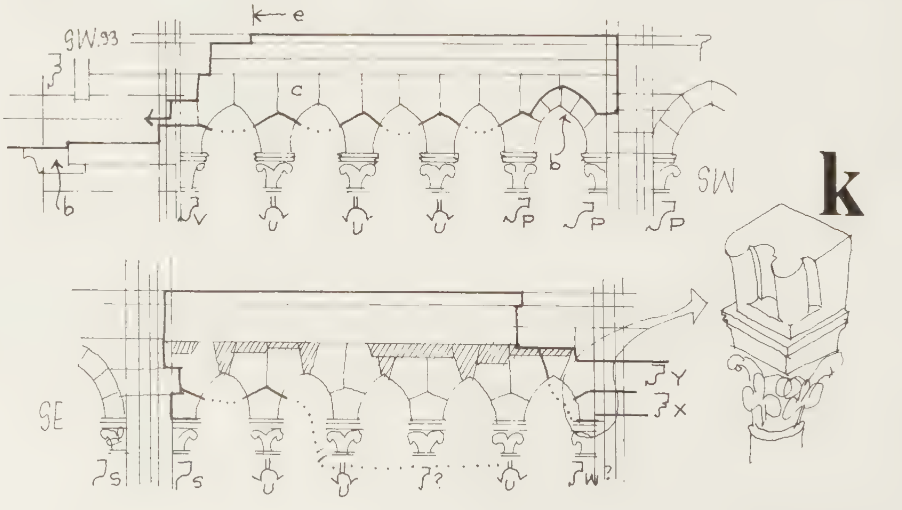
b. Scarlet-V erected the capitals by Rose and himself, and put all the starter blocks over them. From the 'normal' arches in the north bay of the SW he had intended to cap them with normal voussoires. He kept all the columns at the same height as in the adjoining bay, but he tended to increase it to 2,410 at the south end of the SE - and this is the range of heights he had used in the choir - XII:32/III. It is worth following this to the outside for those courses of his which meet other corbels and windows.

c. Ruby capped these blocks with plates using less regular stones on the east.

d. The hatched infills are recent, and some of the blocks may be modern. They give a pattern like a crazy paving, and the joints do not match Ruby's though the principle is the same. Perhaps he had erected them, and they had been damaged over the centuries. Perhaps they are the work of two different gangs, each accepting a basic directive but carrying it out their own way or an adaptation by Scarlet-Y.

e. Later Ruby-a capped them with his corbels. The last stones were laid by others to match Ruby's. I have ringed the work between Ruby-W and Ruby-a in a black line.

f. The bridges over the doors from the stairs are Bronze-X on the east with his chamfered edge, and Scarlet-Y on the west with the same square corner he used in the nave - XII:32/IV. See how these courses relate to these master's work in the stair windows, n.50. Note in the section n.51 how the bridge is later than the other parts of the stairs. It formed a hole right through the stairs and may have been the site of a local hoist. These bridges were formed with the springing of the arches. Notice also how Bronze's moulding does not meet the impost, but starts just above it **k**. He used the same device in the north 'arcades' and the north room vaults - XVII:14/h and 27/c.



bays were not plastered, though everywhere else the coats of yellowing plaster have been laid layer upon layer until the more delicate mouldings have disappeared under its levelling monotony. Occasionally it has cracked, or even thankfully peeled off revealing the true pattern of stonework underneath.

Normally the arches over the arcade shafts were carved from individual voussoirs, and the spandrels filled with horizontal coursing. But in the end bays of the south the pattern is quite different. These arches are made from large stones set on edge, as if the master thought he was building a screen of vertical slabs rather than a wall of small coursing. One arrangement has no technical advantage over the other, but there are enough minor modifications to show that one master did a lot of work on one side and began the other, and that later men had to follow his methods. Fortunately where it joins the stairs on the south we can link this work to the outside windows and corbels.[56]

On the opposite exterior face, on the west of the SW room, a massive arch was built over the walkway. The lowest courses are laid in single blocks, from the outer edge to the wall. Above are two courses with a joint in the middle, followed by two more which are noticibly smaller.[57] The topmost courses are once more laid in single lengths and are larger than the ones below. The changes are trifling, and like the drains may not seem important, but now that we know that a number of teams must have been working on the area we should look more closely.

The corbels under the arch are Scarlet's from 1215. In the next course a window looks out of the room which was begun by his predecessor Rose, though he finished it on the southern side.[58] In front of the window is a screen with thin webs which support the voussoires of the arch. The bases are Rose's too, but the capitals and the webs are Bronze.[59] As the big arch sits on the webs it would not have been begun before Bronze-X, and as there are two large Bronze corbels immediately above the arch there must be a Bronze there too. But when you examine the amount of stonework which has to be built around the arch and the buttresses nearby, and the work to the cells and roof, this latter Bronze cannot be in campaign 'X', but in 'c' in 1222. So we can divide the work in the voissoires between the masters intermediate between Scarlet and Bronze. Can we therefore say that each change in the arrangement of the stones bespeaks another

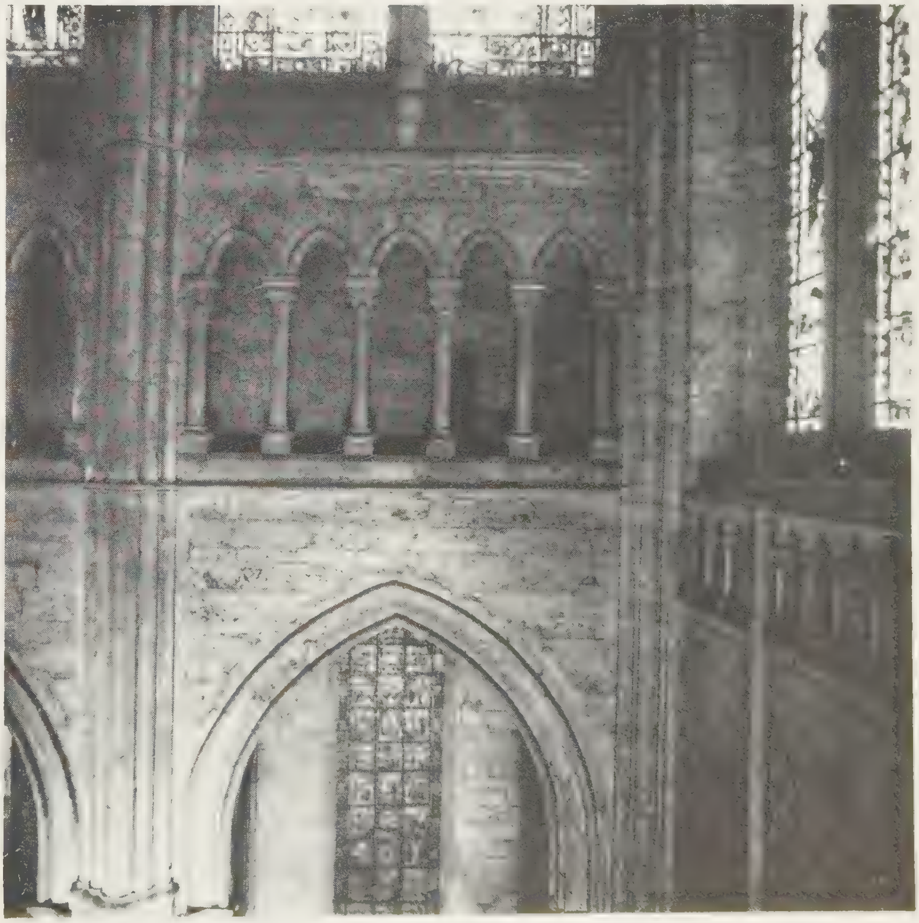


PHOTO 327: The last eastern bay of the south transept triforium with the irregular plate arches.

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[57] See PHOTO:313. This arch was begun by Bronze-X in 1207 to GEOM:XIV-D and was finished by him in 1222 with his corbels under the drain. These are like those in the apsidal towers - n.43/y.

[58] Because the stone with the corbel is not bedded into the wall, but is butted into it, Scarlet comes after these courses of walling which lie under the window. The corner with the corbel is higher than the sill, which is flat. From n.24/f one side of the window is Rose, and the other is Scarlet.

[59] Following n.47/d the bases could be Ruby-W, but if they were Rose-U they were put in with the wall and before Scarlet laid the nearby corbel. Notice their practice of putting in the bases as they go, delicate as they are, instead of waiting until they were ready to install the shafts over them. The capitals are logical and simple and were carved for this situation except for the end ones which were adjusted after being carved to fit into the curve of the arch webbing. They are metal-fixed into the joints in the wall. The web has exactly the same section as the one Bronze used in the SE.II(t) room -XII:35. He installed this webbing in 1217, and using it as part of his formwork began to lay up the voissoires of the arch. This helped me to identify the capitals, for their design is exactly that of the small ones over the nearby colonnettes. These lie under the arches Bronze installed in 1222, showing that these are his too.

master? Or can we put the changes down to sloppy supervision, or to mismanagement in cutting, or even to human error? Or am I justified in suggesting that each change in coursing arrangement is another templet? I have shown it to be so in more important items, like the plinths under the piers, as well as in some less important ones, so why not here?[60]

Here we know there were many men, but are the small differences in these joints sufficient indication of their provenance? Did the master not only issue templets for the shape of each detail, but also for the arrangement of each stone in the arches? How far-reaching was the arm of his authority? Or of the attitude expected from his team? The possibilities are endless, though I do think that even in such a small thing a changed attitude to arch coursing may well indicate another team. At the least we can say that when Bronze returned he reverted to the methods he had used at the bottom of the arch, showing that at least in the voussoires his approach remained consistent each time.

Remember that the crane had been set up next to this arch, so that it would have been logical to omit the uppermost stones of the arch while they were wheeling in the materials for the vault cells and the filling over them. This is even more likely as the outline of the cell and the vault do not coincide, and one was not dependant on the other. Hence it would have been practical to finish the arch in small increments while the inside work advanced to meet it. It only had to be supported on the wall and on the webbing. In the isometrics you can follow how each step in the vaults works in logically and economically with the surrounding work in the walls around the room.

It is fascinating to see how economically and steadily the work progresses. In all these changes there is no evidence that any stone was carved before it was needed. As a part was required the master ordered it to be cut, so when the funds ran out they only had to lay the last of the cut stones to tidy up the job before covering it with straw and leaving the job. The vaults were built in layers like the rest of the building. They did not put up the walls first and then fill inside with a vault. The inside three walls were taken as high as possible, then the ribs were erected and left to hang in the air while the cells were filled in around them. The outside wall invariably progressed with the cells so that none of the vaulting stones had to be lifted higher than was necessary. At each stage the workmen had a secure platform enlarged by the sensible thickness of the wall to stand and work from. The tedious analysis of these vaults has shown me how they were built and has greatly helped in the analysis of other vaults over the aisles and crypt.

The last act around the rooms was to attach and finish off the screen of colonettes. The shafts are *en delit* secured with iron stays into the mortar joints of the buttresses.[61] At the top they are capped with small arches which are cut from large stones, more than one arch sharing the same block. In the west the block also forms the wall, so both are monolithic with the clean perpendicular joints we would expect in walling.

But in the east the arches are cut from thin stones laid over the face of the wall, with joints arranged in a haphazard and sometimes discontinuous manner - angled, sometimes stepped, and even placed one third of the way up the arch, stapled with metal clamps. Many are trefoil, and at the bottom each arch finishes its edge moulding with a characteristic ball mould. They are quite unlike the arches in the west which are all pointed, have a different edge moulding without the ball, and have four-foil recesses between them.[62]

Clearly we must be dealing with two masters. The one in the west lies alongside the corbels Bronze carved underneath the water spouts, but what of the other? On the opposite side of the building there is a passage outside the NE tower room which has identical arches - identical in jointing, tre-foil shape, edges and ball-mould. In chapter XVII I will show it to be the work of Jade, a new mason who had not worked on the cathedral before. We can study him further there.

So we have now reached the year 1220. The rooms in the south and east have reached the level of the clerestory. They are vaulted and roofed, and form the fixed and solid platform needed for the next stage of the towers. Do not forget that at the same time these same masters were working on the clerestory, but before we can examine that fascinating zone we must gather the information we need about the next group of masters, and we can only do that in the clerestory level of the towers.

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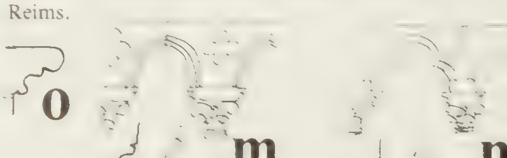
60. For example in the arrangement of coursing under the sanctuary aisle walkway and all clerestory lancets, in the crypt arch springs, in stones over the triforium arcade arches, etc.

61. Modern iron would have rusted away in a few years, and as it rusted it would have expanded and destroyed the stone around it. Today we use bronze in situations like this. They used iron, and it lasted because it was puddled in charcoal ovens from which it acquired a high content of carbon. We have recently begun to manufacture similar 'impure' high-carbon iron to achieve the same effect. The iron grille over the windows into the E.VII(t) room were built into the stonework as it was erected and has remained there ever since.

62. The shape and section **m** of the western arches is identical to Bronze's over the S(p) aedicules - IV:46/o. His love of small 4-foil openings can be seen in his lintels over the north porch - XV:24 - over the ostiums of the west nave - XVIII:49/g; and in a larger form in the lintel over the crypt doors - VI:59. On the west side of the SW tower they are built with two Bronze corbels which support spouts from its roof - XIV:26/a.

On the east the work is by a new crew, Jade, **n**. The cornice over both is the same. Where they meet the window jambs of the lancets under the rose there are recognisable joints: on the east a nib projects out of the cornice suggesting that a heavy arch was to have been carried over the lancets; on the west the stone is a replacement, but on the inside the moulding ends abruptly partway up the curve of the arch. As it is two courses above the (cw) sill, and is above Bronze's cornice, it is by Olive-d. The solid walling over is also his - see n.51 and XX:32. Therefore the frame around the south rose is Olive's and is this shape **o**. Olive therefore made the decision to carry shafts in front of the mullions, and probably inserted the little bases over his earlier sills - n.11. These bases with their small corbel in the centre supporting the torus are similar to some which seem to be associated with Olive's corbel at Reims.



FOURTEEN

Towers - apsidal and southern

Nous pensons en effet qu'il a existe de tout temps, sur un meme chantier, des artistes different les uns des autres par leur age at leur formation; ce fait suffit a expliquer les diverses manieres que l'on peut remarquer dans les oeuvres contemporaines.

Yves Delaporte

There are three separate groups of towers around the cathedral, in addition to the famous pair in the west. The southern ones seem taller than the others, for we see them 'verticalised' by the thin colonnettes which surround them. The northern pair seem somewhat squatter, for the wall under their bases is higher than in the south, there are less shafts round their piers and no colonnettes.[1] For this reason, and for this reason alone, most scholars have considered that the north front was the first, and that the south was the more 'Gothic' and therefore later.

Few people have commented on the eastern pair. From the ground they are not particularly noticeable, and there was no attempt to continue them past the level of the roof cornice. They are finished off square without even a tall parapet, and just blend in with the bulk of the choir. This is a pity, for they are even more 'advanced' and more 'Gothic' than the others, yet no-one has suggested they were built last. They were in fact the first, with the south next and the most 'old-fashioned' north towers last. It is just one more example in this cathedral where the traditional historical analysis by styles has not helped us. This type of study is only fruitful when the work of one century is compared with another. In periods of less than a generation it is dangerously misleading. For in a similar period of change, and over a similar time, we have recently had painters like Picasso and Munnings, musicians like Debussy and the Beatles and architects like Gropius and Kahn. If any of these had been found together on the one work, how would we date them?

The layout for these towers was, as we shall see, established over no more than ten campaigns, the more 'advanced' eastern ones were first, and the others were designed later. The eastern towers have denser clusters of shafts than the others. Where the transept towers have never more than five per pier, the apsidal ones have up to nine. In the transepts they rest on a heavy parapet carved from two sections which gives them a massive footing which tends to hold them down. In the east, on the other hand, the piers rest on the simplest rollmould so it is almost 'unsupported', and this allows its verticalism to seep downwards as well.[2]

The tower vaults in the transepts are supported on corbels which project out of the wall. The vaults seem to cap the structure rather than grow out of it. But in the east they rest on columns which rise the full height from the base, so their vaults are part of a vertical continuum within the towers. Even the colonnettes around the south transept cannot disguise the massive character of its towers, while the verticalism of the east is an integral part of the way they were designed.

Also, between the piers on the south the master has inserted a row of gusset plates. Though they are in the shape of small arches, they effectively impede the vertical movement up the shafts.[3] I presume they were put in to transfer the vaulting thrusts to the outside, turning the tower into a sort of flying buttress. Yet there are none in the east where the need is greater, for there the central

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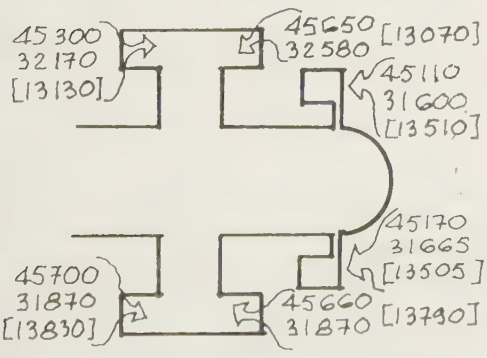
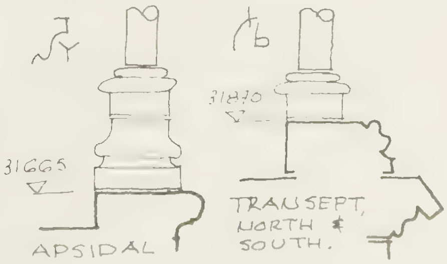
[1] The tallest towers are the south (from top of plinths to roof) and the north are the shortest as they have such a high base. However the NE roof is the same height as the SE to 10mm. The apsidal towers are 500mm lower. You would not think this from just looking at them, but then how many people have noticed that the plinths of the NW tower are 410mm lower than the NE? Figures given in the sketch are the levels above datum of the tower roof and the clerestory plinth, and in brackets the differences. The north and south towers have parapets over the roof which make them even taller than this.





[3] The gussets were placed in the side openings of both pairs of transept towers. I have not seen similar devices in any other contemporary building. Those in the north were probably inserted to maintain symmetry with the south, though by then the east towers had been finished. Green was responsible for many of the details in the north towers which make them look so 'old fashioned' - which raises some interesting questions about his origins. For the high cornice under the towers - XX:28; and the gussets - XX:37/g.

arch of the flyer pushes into the middle of the tower pier with a much more localised thrust than exists in the south.

When compared to the transepts the two eastern towers seem to be in a different class to the other four. Yet within their apparent similarity the real differences become doubly significant. In the ES tower the vault has four ribs supported on four columns which run from the floor of the tower to the springing. These columns lie over the face of walls which form the piers, and in the geometry I have shown that in designing it the master took his vault thrusts into the piers, not onto these columns. It shows that the piers hold it up, and that the vault and its columns were just set over the face of the wall.

Similarly in the piers themselves, the shafts around them are not related to the tower vault, but solely to the openings left between the blocks of the piers. They are arranged between the piers in the way that a window frame is set into a wall - they decorate the piers, and are designed to be seen rather than to carry loads. Hence the design is composed of two elements - the vault which is supported on the plain buttresses which project out of each corner, and the decorative infills which enliven the silhouette and visually help to link the corner piers. The plainer parts carry the load and express the inside elements while the other decorates the space in between.

Compare this scheme with the EN tower. It has a vault of eight ribs, not four, and each is supported on its own column. The geometry began with these columns, not with the walls and piers behind them. The concept is quite different. Cobalt designed the southern one, and in it he first placed the wall, and then let the rib columns fit into the corners as best they could. The north was set out by Scarlet, and he positioned the columns first, and afterwards placed the solids between them. Cobalt determined the vault geometry only after the walls had been fixed, while Scarlet worked the other way round.

Each master has expressed his philosophy in his geometry. If you start with walls the vault is secondary,

Geometry XIV-A

The layout for the EN tower by Scarlet-Y, 1218

The arches capping the walls of the tower room had increased its size to form a square measuring 7,850mm across - GEOM:XIII-D. Scarlet's projecting roll-mould increased this by 135mm to 8,120mm. This is the same as the *actual* aisle span, or 2:√3 the bay. All setting out is taken from the extremities of this moulding - not unlike Cobalt's use of the cornice to set out the apse chapels - GEOM: IX-C. The square was divided into six parts **a** through which he placed the centres of his rib shafts. The shaft as an expression of thrust and force is the *lietmotif* of the design, not the wall masses which actually carry the loads. Appearance supercedes reality.

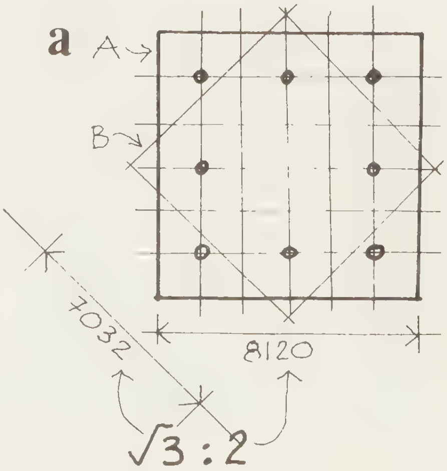
In **b** the real width of the room under the string course shown dotted, W, was used to locate the internal face of the wall round the tower, and is marked E. The splayed plinth under the corner shafts comes from the large diamond in **a** and is related to the bay through the figure **d.** Within these two squares he worked out a shape for the pier which could be placed anywhere as needed, being slid as it were along the faces defined in **a** and **b.**

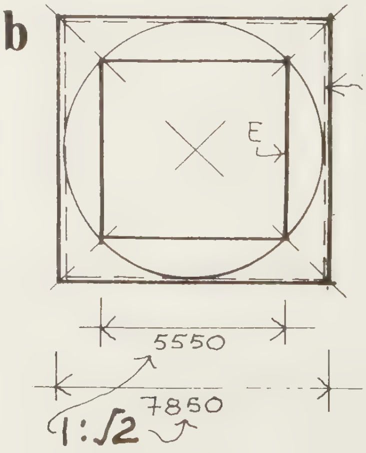
The pier is designed from Scarlet's PM of 354mm like this. He used three for the centres of the inner row of shafts in **e**, and combined this with a unit 3½$^{\mathrm{PM}}$ to create the pier. One operation using the 3½ is followed by one using the PM, which is in its turn followed by another derived from the 3½, and so on. This beautiful mannered geometry evolves like this:

a. Rib column centres from tower width by sixths in **a.**
b. Shaft centres fixed as 3$^{\mathrm{PM}}$ from W in **b.**
c. The tower width minus a ninth determines the outside face of the pier F and the side of the bases to the end of piers P. This gives the shaded square.
d. The diagonals right across the tower from M may have located the splayed sides of the pier bases, though they are not always at 45° to 'c'.
e. 3½$^{\mathrm{PM}}$ forms the dotted diamond along the outer face of the plinth and through the end shafts and 'b'.
f. 3$^{\mathrm{PM}}$ forms a diamond which passed through the centres of the pier shafts.
g. 3½$^{\mathrm{PM}}$ forms the width of the plinth within the shafts and the inside face of the pier form M. It forms the square with the hatched outline. This is close to √2 times the ninth part in 'c'. So here Scarlet brought his two unrelated systems into a close relationship. He expressed its importance. by *not* continuing the moulding of the plinths on the inner face K, even though it is continued under the shaft supporting the ribs.
h. 3½$^{\mathrm{PM}}$ is the width of the gap between the centre and the corner pier on the choir side. See later how this 'ideal', was modified on the other sides.

This geometry is the complex combination of many simple parts. Typically he is using modules, rather than irrational figures. There is no hint of a free-wheeling compass, nor of pentagons or octagons. His prowess lies, as it did in his first plan, in his ability to combine a number of linear systems. See also his design of the west rose in James, 1973(2).

The openings in the tower vary, the widest being on the southern face opposite the clerestory windows C in **h** and the narrowest being on the sides adjoining the stairs. This was arranged in a series of steps. Firstly the thrusts from the flyers were expressed by reducing the openings in that direction by 610mm, (which is the width of the flyer arch) and then the encroachment of the staircase was absorbed into the other two sides by reducing the opening further as shown in **h.** The number of steps in each reduction are indicated with





as it is in most Romanesque buildings. The columns and ribs are applied over or within the structure. They are not essential elements, but decorative. On the other hand if you begin with the columns the axes they form are primary, and so the visual comes to be emphasised more than the structural, in the sense that no column is really strong enough in itself to carry the loads of the vaults. They are carried by the wall. The column *in fact* only represents a symbol for a localised thrust, not its actuality. The master would know this, yet by designing out from the column rather than from the wall he showed that he thought that their apparent function was more important than the actual.

The many geometric studies I have made for Chartres have convinced me that some masters believed that their columns represented the real forces of the building. Scarlet visualised his tower as an enclosed web of energy, perhaps like a magnetic field. Cobalt's view was more traditional, and was structurally more accurate. He saw his tower as a tall room with four walls, through each of which he punched a pair of windows. The walls do the work, and should be seen to do it.

However the architecture of the future was being fathered by Scarlet's philosophy, not by Cobalt's. One immediate consequence of column-focused geometry was that other elements were to be modified by the new scheme: surrounding shafts were no longer placed to suit the self-contained logic of their openings, but were adjusted to reinforce the primary concept of a web concentrated in the columns. This is why the inner pier shafts in the EN tower were set back so they would relate more clearly to the columns supporting the vault. Though they still decorate the openings, their arrangement stems from the structure. The consequences to the future were, as we know, enormous. The EN tower is an internalised and integrated statement, while the ES is externalised and additive. Though they both have the same thin openings, the same light verticalised shafts and the same sort of mouldings at the base, only in the north does the whole tower participate in the task it has to do. With eight ribs

arrows. The stairs do not lie exactly on the diagonal of the tower, but are set closer to the eastern side, so that the eastern openings were reduced more than the north. In all of these adjustments the rib shafts remained in their correct positions. The openings and the piers were just slid across them.

See how the design order is to firstly locate the columns, and then the rest of the structure is laid out for an idealised tower without stair or thrusts, and lastly it is adjusted to compensate for each of these factors, each individual adjustment being added on to the one before. The very last act would be to accomodate any twists in the sides of the tower. We have struck this method many times before - particularly in the first plan by the same master in ch. VIII.

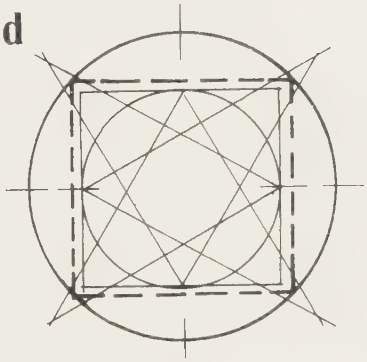
It is important to realise how carefully these masters worked at their geometry. It was no casual business, nor just a tool, nor just a quick way to set out. It was the very stuff of their design method. Every step implied certain philosophic concepts, and they were trained to recognise them, and then to act on that recognition.

Thus the tower not only reflects its own structural dynamics, but also every part of the building impinging on it. It is not a campanile which just happens to have two flying arches resting on it, but is like the tree which tends throughout its life to approach an idealised form, but twists and bends to the real circumstances around it. Without this the tree would collapse in the first gale.

Scarlet's geometry is analagous: the tower begins with an idealised perfect solution as if it was to stand on its own, and is then progressively adjusted. The design is the result of a natural organic process. Is it then any wonder that the master cut a different templet for each stone, and that the mass production of standardised components could not form any part of his thinking.

...*/XIV-B, C, D & E/XX-A...

d



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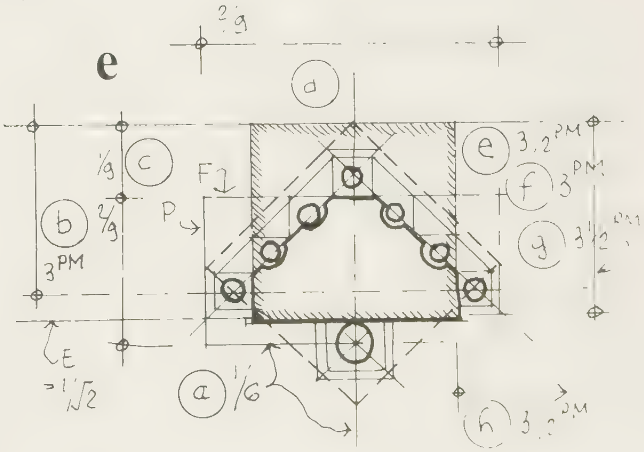

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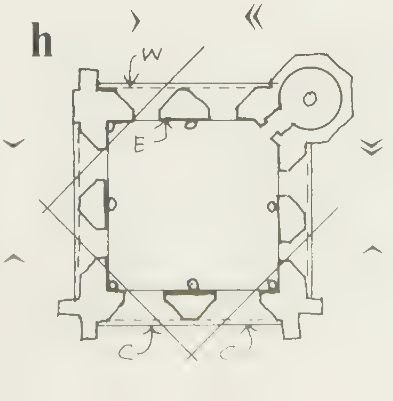
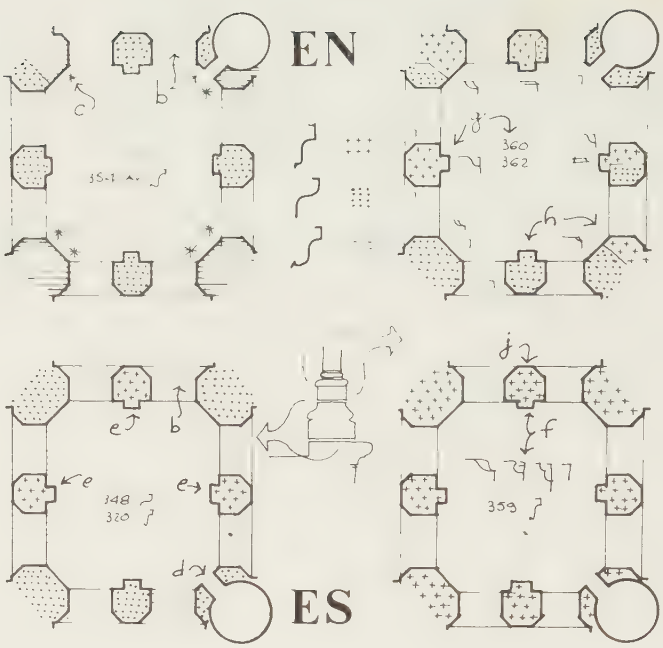


4. The spaces are also modulated to suit their functions. They are wider between the flyers on the innermost side, and narrower on the north where greater lateral strength was needed against the thrusts from the vaults. Their openings are mathematically related to the same series used in the piers. The method whereby structural elements were designed around and from the abstract lines of the axes, rather than from the mass of the wall, can first be seen in Bronze's double windows in the sanctuary aisles. The implications are discussed on p.204.

5. EN(cw) was begun by Scarlet. He cut his stones for a $2^{PM}:2^{RF}$ opening as in his EN.IV(t) door. The jamb is based on 60° triangles in **a**. The ES(cw) is Cobalt's in **b**, though not to the pattern he had used earlier - XII:4. I am inclined to think that Scarlet may have begun the lobby on the east, while Cobalt did the other side setting the side of the lobby in line with the door newell as in XIII:7/f. The ratios seem to be $\sqrt{2}$: 7: $\sqrt{10}$, in which $\sqrt{5}$ is his foot. As this is not the same geometry as he used 12 years before in XII:4, has there been a change in masters?



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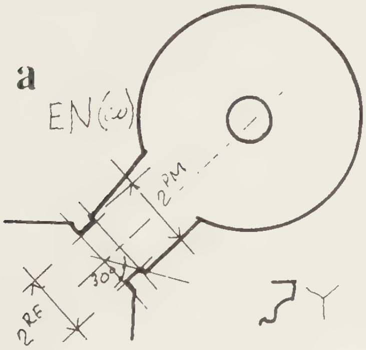

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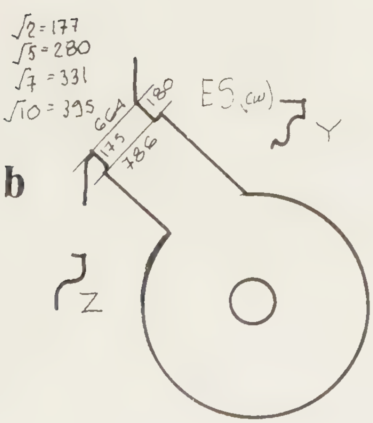


6. See n.2. There are no exceptions, though in a number of cases a continuous plinth has been built under the shafts with the same silhouette as this moulding, as in the north porch piers, the transept towers, the colonnettes and in the transept roof galleries.

8. The eastern towers:

a. *Plinths:* The geometry shows that the towers were set out differently, Scarlet in the EN, Cobalt in the ES - GEOM:XIV-A & B.

b. EN string course under the plinths is Scarlet with his door. The full set-out is implied in this course.

c. Plinths have an average heights of 354mm, or Scarlet's PM. Ones with an * were designed for a narrower shaft base, so the later bases either overhang or were shaved off to fit. I adjusted the attributions to suit these places.

d. I gave the rest of the plinths to Cobalt, and the first in the ES. Average height 350mm. He began the ES(cw) door. Scarlet lies in the course below the plinth with possibly part of the door lobby.

e. The short ones in the ES are Ruby-a, but the course has a height of 1^{CF} - see XX:26 for this confusion.

f. *Tori:* All the ES tori are the same, 359mm high, with characteristic Rose/Ruby corners - XIII:47 and XII:32/II.j.

g. There are a few in the EN with similar corners and heights.

h. In the EN all the Cobalt tori meet the splay as in **c** while the others work to **d.** Cobalt cuts the corners off his bases as he did under the 'temples' over the south porch - ISO-N. However, in the ES both methods are used in tori which are unmistakeably Ruby, once on the same block of stone. Had Ruby left this detail to his men? or had some of his cutters been working in his traditional manner while others were trying to be consistent with earlier work? Or did another master finish this block? Or is this another example of Rose and Ruby mixing their gangs - IX:33.

i. The EN upper tori roll mould stops at each shaft, while in the south many are carried across the pier between the shafts. Same comment as in 'h'.

j. Ruby finishes the inside pier with steps - n.24. The enlarged buttress must be Cobalt as the original size had been established by Scarlet - XIII:43.

k. In the section **e** I have shown the flyer arch begun by Ruby - XIII:43/aa - and the gussets over it begun by Cobalt - XVIII:58 - and the pier of the tower where it was enlarged up to 130mm marked x. This enlargement continues all round the choir showing which parts were laid together.

In assessing which masters made the critical decisions leading to the choir flyers being so different from those in the nave, these junctions were important.

The dimensions and the geometry of the lower arches show that Ruby-W reduced their widths compared to the nave, and altered the arcs - XVIII:45. The projecting stone X was placed after Scarlet's tower plinths in the north, and so this stone was by his successor Cobalt who, again from geometry, was responsible for the 3-foil gussets and the spokes - XVIII:58.

But in the nave the frame along the top of the lower arch had been turned up at the inner edge of the gusset, so that it would be the same width as the flyer arch. But in the choir the gusset is a thin infill stone, and the decision to make it thin lies in the frame over the arch, for it does not turn up along the inner face of the gusset, but continues almost to the springing of the arch. This decision could have been Bronze-X, or even Ruby-W in the first and second bays. Scarlet and Cobalt inherited it. The extent to which the frame narrowed the flyer therefore determined the thickness of the gusset and its appearance as an inserted infill.

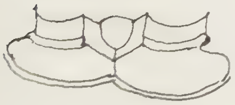
on eight columns resting against the eight piers all the wall elements, the intermediate ones as well as those in the corners, are involved in supporting the vault. It is indeed a masterfully integrated design.[4]

It is a pity that the EN tower is tucked out of sight behind the sacristy and the trees of the Bishop's park. It is the finest of the six new towers of the cathedral. It is more complete in itself than its brother in the south, and more unified and delicate than those in the transepts. In many ways it is one of the most elegant to be found in Europe at a time when Gothic France was becoming famous for the natural grace of its architecture.

In spite of a few replacements made about 1900 to the base mouldings under the piers, it is clear that the different plans were determined at the level of the plinths, along with the doorways out of the stairs.[5] In the drawings over the page I have shown how the three courses relate to one another. The bases are made up of two courses, one with a curved moulding which is carried continuously around each pier, and above it the torus moulds to the shafts. This is the only occasion in the cathedral where the column bases sit over such a moulding, though it was not uncommon elsewhere.[6] Everywhere else the torus sits over a simple splayed moulding which, in spite of being the commonest form of plinth at Chartres, is seldom found in other contemporary buildings. We cannot say that the more complex plinths are stylistically later, for similar ones are to be found under the crossing of Soisson at the turn of the century, at Lagny about 1205, in Reims, Essomes and elsewhere. It is a more popular detail than the simple splay used at Chartres.

The shapes of the plinths and the tori are different in the north from those in the south, as are their dimensions.[8] There are also variations within each tower showing that more than one crew worked on them. Once I had unravelled the pattern, the problem was to relate each to a specific master. There are a number of clues above the pier bases: the southern door has Bronze corbels on both sides, the north has Cobalt on the west

c



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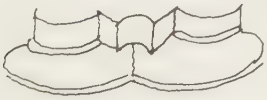
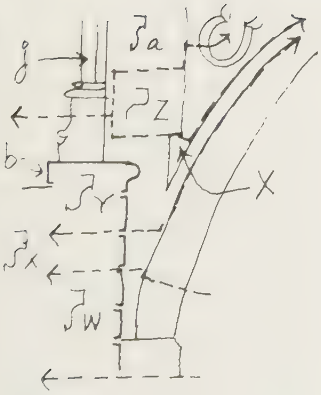


e



Similarly the capless and baseless spokes were affected by earlier decisions. Scarlet-Y had laid the course over the arch against the clerestory wall which, if it had followed the work in the nave, would have included a base for the adjoining spoke. Scarlet may have intended to carve the base with the shaft, as was later done in the east transept flyers. This suggests that where a column was thin and could not be visualised as being structural, the base would not be carved integrally with anything that was structural. The bases to the thin colonnettes round the south transept are separate, while those under the larger shafts in the adjoining triforium walkway are integral. The bases under the full-height shafts of the south towers are integral while the inner ones under the shafts which support the gussets half way up the tower are not. There is a consistency here not unlike todays 'form-follows-function'.

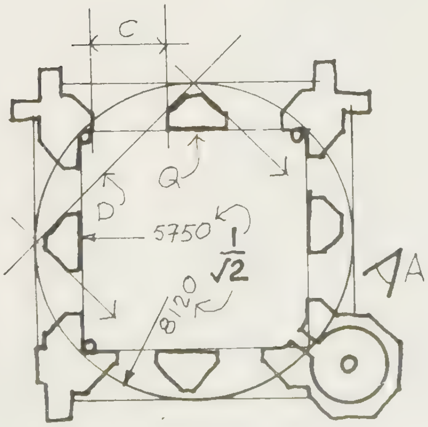
However that may be, the changes in the choir can be listed:

- Ruby-W: thinner flyer arch
- Ruby or Bronze-X; alters frame and begins it at the springing.
- Scarlet-Y: no projecting base for inner spoke.
- Cobalt-Z: gusset with 3-foil opening and unarticulated spokes.
- Ruby-Y: pointed arches with pierced oculus.

See XVIII:30, 49 and 58.

Geometry XIV-B

The Layout for the ES tower by Cobalt, 1219



The box under the EN tower was reasonably square, but not the ES. The worst side is out by 2°40'. In the many changes made to the plan of the cathedral this part suffered most - it has the smallest buttress, the widest bay, the most constricted staircase, and so on. Some of these irregularities were smoothed out within the triforium zone, and others in the arches which encase the towers. However the plan of the tower still reflects the alterations below.

As far as I can judge it was set out from an idealised square shape, and then the centres and sides were shifted to suit the actual. Where the EN tower is 8,120mm square, the ES is rectangular - 8,230 x 8,010. The average of these two is the same as both dimensions in the EN.

Cobalt set it out to the wall faces behind the rib columns, not to the column centres. The space between the pier walls is 5,750mm which is excactly √2 times the average tower width taken to the edge of the stringmould. Ideally the plinth fits within the diamond D and the square Q - this was not taken to the bottom part of the plinth but, as with the wall, to the reduced part above it. The enlargement of the plinth was a part added over its essential form, an attitude which Cobalt was to continue into the design of the pier itself.

Unlike Scarlet he tried to keep his openings equal, and only reduced the eastern ones to make room for the stairs. On the three 'normal' sides the space between the shaft centres C is one-third the interior space. Being so warped, it is very hard to get more out of it then this, though knowing Cobalt's careful ways, it should be there.

...XIV-A/*/XIV-C, D & E/XX-A...

and Ruby on the east. Over the south the lintel nearest the stairs has a curved rebate cut in the soffit to take a door swing, while the stone on the outside is cut differently.[9] This stone has a groove in it for a pin hinge, just like the ones put into the aisle walkway doors downstairs.[10] As Bronze cuts recesses for his door swings it cannot be his.

Nor can we call it a sloppy change by a master who did not care - just examine the shape of this lintel.[11] It is a most complex piece of cutting. No two faces are parallel. When examined in place you can see how well it fits, each curve behind the shafts exactly fitting over those underneath, and the recess on the underside of the stone fitting exactly over the sides of the doorway. There is not even a discrepancy of a couple of millimeters, not within the door, nor down the curved and angled shaft recesses on either side. Consider the number of templets the master would have used for this one stone, and then consider how when making all these decisions the master must have considered and *decided* to make this change. He would have had to ask for five separate templets: one for the plan, and another for the recess underneath, one for the inside face and one for the outside, and perhaps a fifth to explain how the moulding folded back underneath. There is nothing casual in the information the cutter would have needed to produce such a stone, and equally there can be nothing casual in the changes.

Now on the north side the lintel has the same groove, but across the whole opening. Both north and south lintels are the same height from the floor, and both have a moulding just above it which forms a plinth under the column in the corner to support the vaulting. I apportioned the stone with the curved rebate in the south to Bronze-c, and the two grooved stones to Rose-e.[12]

At about the level of the lintels, small windows look out of the stairs. The southern one is eccentrically arranged, with a pair of splays based on the 325mm foot of Rose. The northern one is characteristically Bronze.[13] Look at the schematic elevations.[14] Both windows are set lower down than work by the same masters over the nearby doors, which shows that these stairs were not built

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[9] Recesses carved into the underside of the lintels for door and window swings occur in: Sacristry window on east side by?

N(p)	- Bronze	- XV:36
ES.II, ES.III(t)	- Red	- XII:35/d
E.VII door (t)	- ?	- XII:38
WN(t)-E	- Bronze	- XII:5
ES(cw)	- Bronze	- n.14
NW and NE(cw)	- Green	- XX:30
SE(r)-N	- Bronze	- XX:42

The majority are by Bronze from 1208 to 1242. See also n.26/d.

[10] See discussion X:19. They are exclusively used by Rose and Cobalt.

[11] The lintel over the ES(cw) door. Apart from the complexities of its outline, the underside has been hollowed out for the head over the door jamb J, and for the shape of the lobby L. Inside that a further groove was cut out for the door hings G. On the top of the stone over the door there is a moulded projection P to support the plinth of the shaft which continues above the door. See PHOTO below and n.14.

[12] For other Bronze lintels see n.9 and for Rose's see X:19. See implications in the elevation n.14.

[13] *Geometry for the ES.122 window by Rose-e,* 1224.

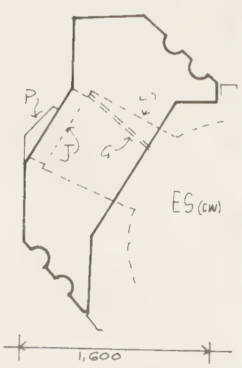
It is not the same as the geometry he used in the south porch 20 years earlier, but the foot is unchanged, and he approaches it in the same circumspect manner - concealing the inner regularity behind an outer waywardness. Compare IV:17, 18 and text. He followed Olive's move in the EN to reduce the tower, above a small moulding n.14/k and as the work was lower in the south he designed this window to the slimmer wall *above* this moulding. Begin from the centre of the wall W, and join this to the newell N in **g**. Step across CF ÷ √2, which is the only part using his foot, and run the middle of the window M parallel to WN, shown dotted. Bisect the wall thickness along WN at U, and extend the line from it to mark the centre of the window. This part is just like SW.31.

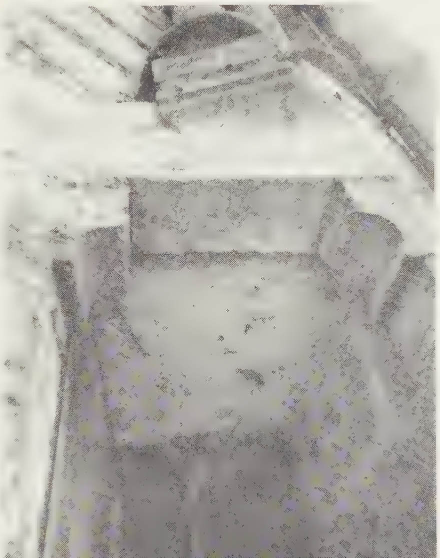
But instead of forming the inside triangles across the opening, he extended the centre line VW by one-fifth, to K in **h**. From K he formed one side of the internal splay either (1) from the pentagonal triangle of 2:φ, and repeated a matching one on the other side, or (2) by fixing the point of the triangle J at one third of VW from the outside wall face, and then by joining J to K and its partner L. Either approach would have been consistent with earlier work. The window is too small to be certain.

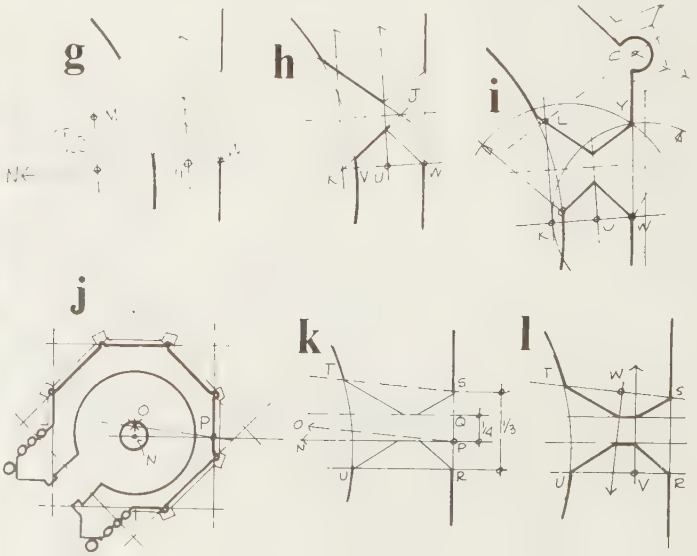
Lastly in **i** mark Y with either of the arcs shown, and then join W and Y to the intersection of the wall centre from U with the internal splays to form the outside. There is a 'coincidence' which may have been one of the generators: the 45° line from the centre of the tower to the outside colonette C meets the line from K at L. In this case the first step in forming the window would have been from where the two axes through W and C meet the CFx√2 length KL.

Geometry for the EN.126 window by Bronze-c, 1222.

To see how he did this one we must, as with the others, begin with the whole plan for the







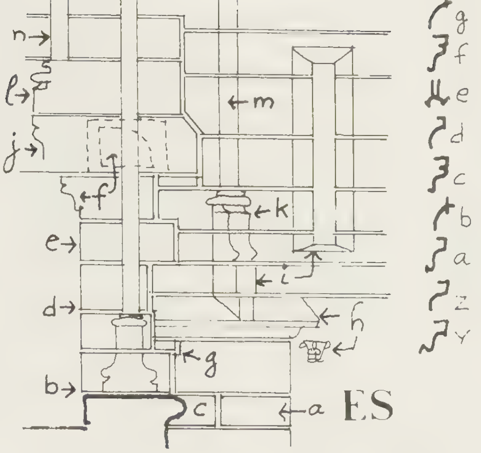
stair enclosure **j**. As the same construction is repeated in the three windows above this one, I am confident about its geometry. Notice that in this case the window is set out below the moulding in n.14/k which reduced the wall thickness. Part of it is formed from the two squares which produce the octagon. Though I have found the stair geometry too elusive, I noticed that the centres of the squares do not lie over the newell. So his first step was to draw the line at right angles to the outside wall from N, and where it met the outside wall at P he joined this to the centre of the octagon O. In **k** he marked off PQ equal to a quarter of the wall thickness, and centrally around PQ he marked off another width RS equal to one third of the stair radius. RU was drawn parallel to the line NP and ST was drawn parallel to PO. The outside corners of the window will now lie on RSTU.

Along UR in **l** mark UV equal to half a foot, and at right angles to that draw up from V the outside edge of the slot. Similarly place W two thirds of a foot in from S, and draw the inside of the slot square to ST. Now form the faces of the window by joining intersections.

This is totally consistent with his other windows, but notice how his ideas have been developing. Compare the first ones he cut in the porches with the SE.67 corner window and with these to see his growing realisation that the geometry can be built up from proportions of the wall thickness and the stair size (GEOMS:IV-G & H). This would make the opening as seen from the outside reflect the largeness of the stair void, while the width of the slot indicates the thickness of the wall. It is a neat system and is infinitely adaptable to all types of stairs.

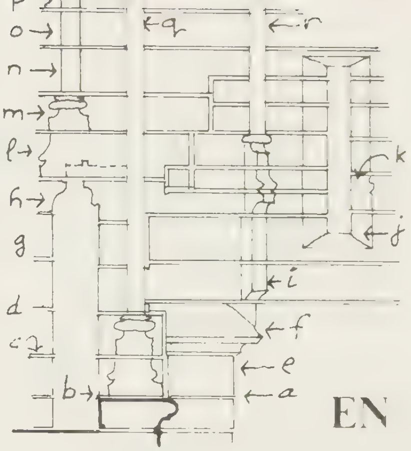
14. *The ES door and the outer part of the tower.* Shown in PHOTO:335 below.

a. For the courses below the cornice see XIII:43, 46, 47.
b. For the plinths and tori - n.8
c. Scarlet's plinth stone returns into the side of the stair tower showing that the two parts were built together. It locates the joints around the staircase.
d. This is the start of the moulding behind the shaft which is discussed in n.17.
e. This is the course discussed over the page, see PHOTO:337. There is a joint against the mouldings. I gave this stone to Jade-b because in the EN tower where the moulding was first implied he had stepped in the course underneeath - n.17.
f. Bronze corbel. The lintel on the inner half of the stone shown dotted is discussed in n.9 and text. See how this part around the door was raised considerably above the rest of the tower, and I think they did this because they needed the jambs to support the scaffolding so that the doorway could be kept clear. Elsewhere the wall was left low for access to other scaffolding, and it may have helped support a roof over the stairs.
g. the infill stone emphasises the change in coursing heights - n.18. By Ruby or Bronze ex the elevation XIII:46.
h. The cornice was begun by Bronze in 1222. Olive did the work on the west - n.20 and XIII:47. The capitals over the aedicule are his too - XIII:47/e.
i. Course by Rose with his window - n.13. The width of the base under the shaft was increased to I^{CF} on the east, and he reduced the tower size to match Olive's in EN.'k', below.
j. The coursing shows that the outside of the lintel with its groove was laid on its own - n.12 and nearby text.
k. Torus is a Bronze type, not Rose. You can follow the joints on the coursing below and the rougher work at this level, and especially to the west of the door.
l. Another Bronze torus begins the corner vault shaft. The torus does not align with the projection on Rose's lintel. Follow the courses on the inside to see the extent of the work around the window. It is confirmed by the changes in surface texture.
m. The colonnettes up the corner of the stair turret are engaged with each course -Bronze.
n. Corner shaft *en delit* by Jade-g - above this elevated in XX:40.



The EN door and the inner corner of the stairwell

a. and b. as for ES.
c. The stair geometry alters between the tower floor and the window, for its centre has been eased over.
d. As for 'd' in ES. Begun by Cobalt-Z or Ruby-a - n.17.
e. Ruby-a's course is not to the same height as the plinth - as in ES 'g', see XIII:46.
f. Though this stone is a replacement I am sure that the cornice was begun by Ruby-a on the east, through to Bronze-c on west - XIII:46. The capitals over the aedicule are mainly by Ruby - XIII:47/e.
g. Good perps and faces on the left, by Cobalt. The rougher work on the opposite side is by Ruby.
h. Corbels by Cobalt-Z and Ruby-a. The latter's are a little like Red, but refer to similar problems in XIII:34 and 37. The door jambs were raised above the level of the surrounding work for the same reasons as in ES 'f'. Round the Cobalt corbel there could be a joint to below the cornice 'f' on the west side, in which case it would continue the pattern illustrated in n.18. However, it could step the other way so that Cobalt would have come after the sill 'i', in which case the grooved lintel would have been his laid at the same time as his corbel.



The coursing behind the shafts around the tower would suit either interpretation. Putting Cobalt above Bronze-c of the EN.126 would have forced me to introduce another crew to explain all the joints in the north between NW.64 and the gallery door - XV:40. I chose the more economical solution, which has the advantage of producing a consistent building sequence, as in the ES door.

i. The shape of the base under the corner colonnettes was altered by Bronze.
j. EN.126 by Bronze - n.13.
k. Both the next two courses are cut from CF stones, but not for plinths as Rose had used in ES 'i', so I gave it to Olive and hence he began this reduction, confirming that the ES 'e' must be before his campaign - n.19. The torus has his splayed corners - XII:32/II.
l. Lintel by Rose - n.12.
m. Characteristic base by Rose, though there is a slight misplacement with the lintel.
n. First course *en delit* by Rose.
o. The next course is engaged, as with Bronze in ES 'm'.
p. However, Bronze continued the *en delit* shafts further up to match the other *en delit* tower shafts? - XX:40.
q. Changed outline of wall behind shafts discussed n.17.
r. Colonnettes up the corners of the stair turrent are *en delit,* begun by Rose and continued by Jade. Another useful though not always reliable correlation across both towers is to follow the consistent use of engaged or *en delit* shafts by each crew.

up as a series of rings, but with one side constantly higher than another. It is an understatement to say that the joint around the doors are rather complex. It was very tricky, and if it was not for the many valuable clues to be found here I would have left the area alone. I have arranged all the clues around the drawing if you would like to follow them: it turns out that ten teams worked on the doors erecting no more than nine or ten courses between them! The work was slower here than anything else in the cathedral.

When I examined what the same men were doing in the clerestory of the choir I could see why the doors stagnated. Follow this in the section.[15] While the doors lagged the same masters were building all three rows of flyers, the whole of the choir roof, and even the main vaults themselves. Ten courses at the stairwell against the thirty six or seven needed to finish the clerestory windows. The stonework in the choir is tied to these towers, for you cannot erect the one without at least working on the inner piers of the other. The outer piers could have been left until the end, perhaps advantageously for they would not then have got in the way of the scaffolding. The big cranes were next to these towers and tall outer piers could have interfered with the delivery of materials.

There is a small detail which confirms this idea: in the south the stonework of the piers behind their *en delit* shafts has one sharp and one rounded corner flanking each curve, and in the north both are sharp.[16] But in the north follow the shape of the piers to the top of the tower, and you will see the detail change partway up into the shape used in the south. Draw the heights of the change in each pier, and the tilt is obvious.[17] On the inside the change occurs at the height of the tower vault spring, which is well above the start of all three flyers' arches. Hence the change was made by one of the last crews to work on the clerestory, and by following up the line of the arch in the section it coincides with the cornice under the main roof.

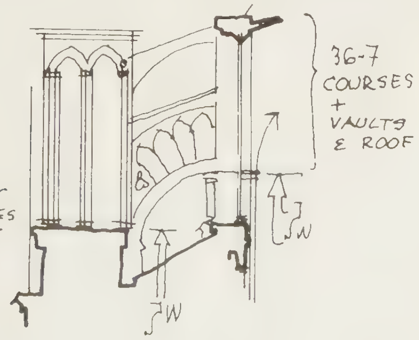
On the outside the change drops lower and lower, until at its lowest around the staircase it is at the level of the course above the little window which had been started by Rose in 1224. The choir and its vaults were just about to be finished before the masters took the eastern towers above the lintels over the doors. Without the confirmation of this detail I would not have suspected them of holding the stairs back so much. It came as a surprise, yet when I drew it up on the isometrics and could see it in relation to the crane and the movement of materials I saw the logic.

When they were first setting out the towers they hurried on with the doors out of the stairs so they could be used to give access to the nearby scaffolding. Then for the next decade they happily left the area alone, just pottering around the doors, adding the occasional stone here and there as they had the time or the ingenuity.

Now that we can see why, we must return to the problem mentioned earlier: how do we disentangel ten crews in almost as many courses? If we expect to find a bewildering variety of breaks and joints we shall not be disappointed. Look at the ones in the south side. The photograph shows the north east corner of the stairs, being taken from A in the drawing in GEOM:XIV-B. The essentials of the photograph are itemised in the sketch to make the discussion easier.[18]

The cornice C is butted hard into the torus mould of the nearby shaft, part of which has been knocked off. It was not knocked off later, nor is it the result of time and weather for the edge of the cornice rests hard against the broken portion. The plinth under this shaft is 350mm high, and the same stone continues to the left underneath the adjoining wall. But above it, and under the cornice, there is a small infill which has raised the cornice another 25mm above the plinth shown black. The adjoining stones are all cut to suit the new height, and their surfaces are smoother. The dotted line shows the joint from the

15.



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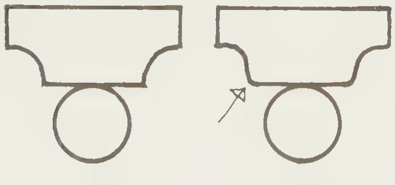
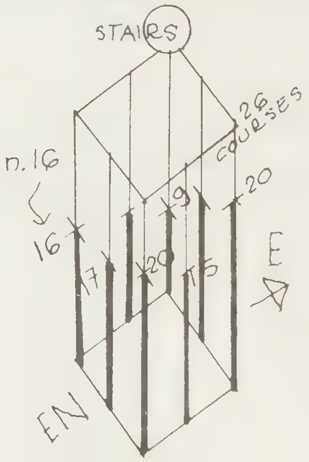
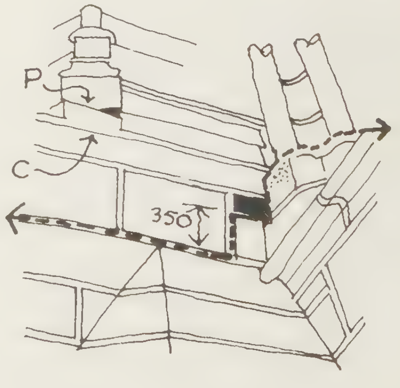


17. The ES detail was begun by Bronze-c (or Jade-b?), while the sharp corners in the north are Cobalt-Z or Ruby-a. The change in the outline in the north was by Bronze-f. Consistent again. The courses are marked on the sketch where you can see that the stair pier was the lowest, the change occuring only at the ninth corner out of twenty-six. See n.14 and the elevation in XX:40. Bronze was also responsible for the similar courses on the top of the choir flyer arches - XVIII:58/a. Further up the EN buttresses were set back on the outside with a series of splayed steps which are not very noticeable from below, until the larger ones had been reduced to the size of the adjoining ones. The same technique was used in the ES, but the steps start higher up. It fits in with Jade's program, and again shows the delays on the north side compared with the south. See XX:40.



18.



top of the torus to the bottom of this course.

By contrast, the cornice of the northern tower is lower, and finishes below the torus. Its projecting lip butts against the flat surface below the moulding in a neat tidy solution which could have been repeated in the south. Both cornices are carried around their staircases, and at this point the walls around the stairs are square in plan. Above them the stair changes into an octagon with a small colonnette up each corner. The colonnettes rest on small plinths carved into the stones of the cornice.

In the south the plinth P does not project in front of the lip of the cornice, but in the next two courses the shape was altered, so that a corner of the plinth now projects over the one below. They are not the same size in either tower, nor are they in the equivalent courses.[19] The joints are clearer on the other side of the stairs where the projection is greater, as you can see in the photograph on page 335. In the lower one the face is angled so it would not project in front of the lip of the cornice, but in the next course it is set square to the stairs. The overhang is well marked. Above the plinth course there is a moulding which reduces its size, but notice that it is also angled to the one below.

On this side there is the same small packer between the top of the plinth and the cornice, and with the same misalignment between the torus and the lip. Above the moulding under the colonnette the plinths just butt into a plain stone, clearly visible on the photograph - a stone which shows no indication of having been reduced to suit the plan for the rest of the stair at this level. This course must therefore be earlier than the moulding. By following courses it was built with the jambs to the door, which had therefore been built before the outside of the stairs. As I said earlier, it would have been logical to build just enough of the doors so they could be used by the workmen, but not logical to spend more time or energy in cluttering up the site with the outer walls of the stairs. I presume they bothered to build the door frame because it could then support a lean-to roof over the stairs, which would otherwise have become slippery with rain and frost.

Now return with me to the northern tower, and look at the same level. There is another pattern of joints here not unlike those in the south, but producing different results. It is the point where one form slides into another: where the square behind the aedicules is transformed into the octagon of the stair turret, to which there must be as many possible solutions as there are masters. Each crew seems to have played with one part or other of the design for the stairs. Whenever the master had time off from more pressing problems in the flyers he seems to have fiddled here.

Considering the number of crews who worked here, it is surprising that there is any unity at all. But on the principle of symmetry, as one crew decided to make a transition on one side, the next would make a similar one on the other, handling it differently, but with sympathy.[20] Hence the design changes made on one side would be reflected on the other, though the details differ. The formal fundamentals are the same, only the details and the geometry change.

There have been many examples of one master maintaining symmetry with the work of another, but it is usually only across one axis, seldom across two. For example, the cross walls behind the triforium passage match across the nave, and across the choir, but there is no symmetry on each side of the transepts between them. Symmetry is almost only taken across the major local axis. So we find that the eastern towers are similar to one another, yet quite distinct from their closest neighbours in the transepts. Later on we shall see that the symmetry of the nave and choir flyers also stops at the transepts, so that the ones on the east are more like those in the choir than the ones opposite. Here symmetry is one sided, and when there is an alternative, balance is maintained across the larger space.

After all, they could have matched the ES tower to

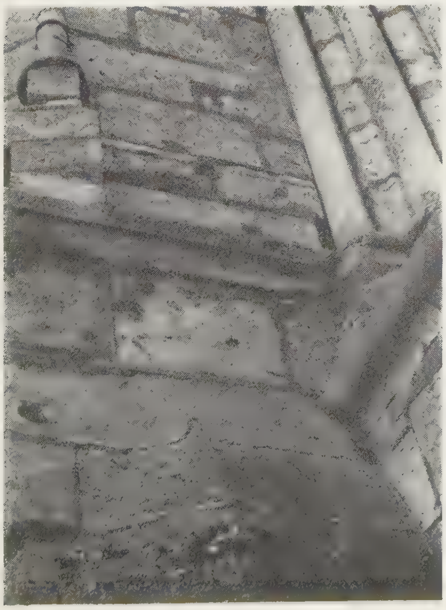


PHOTO 337: The transition in the ES tower between the square enclosure around the stairs and the octagonal at the level of the clerestory string course. The photograph was taken from A on plan p.333.

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[19] I could not measure the width of the colonnette plinth in the lowest course. The next is over 320mm, the third is 360 reducing to 255mm under the torus. None match, so I apportioned each to a different master, which was a handy way of dividing up the programs between the plinth and the window. They are drawn in the section in n.8 and in n.14/ES.h and EN.f.

[20] Refer back to the discussion on symmetry in the text after XII:17, and XIII:20. The cornice transforms the stair from a square to an octagon. It was first intimated by Ruby-a in the EN - n.14. Follow the connected parts in the aedicular roofs - XIII:46 - and the minor changes to the shape of the buttress ES.III and EN.III at the clerestory level. This confirms that the inner parts of the aedicule roofs on ES.II, III and EN.III were all Bronze-e, using an identical section to the Bronze cornices under the south transept towers - n.2. Round the EN stair we can distinguish the east side cornice by Jade-b (using a 5:7 slope and modular divisions, as in n.26) from the north side by Bronze-c, in which the junction noted in n.18/p has been smoothed out. Around the ES we can distinguish Olive-d on the west (using a similar slope to Jade) and Bronze-c on the east. These attributions were not finalised until after drawing the isometrics. The arrangements are illustrated in XIII:46 and 47.

those in the south so the elevation would be unified. The fact that they did not shows they did not think in terms of elevations, but in terms of axes - and as there were four of them radiating out from the centre, they each ended up imposing their own separate order. It was like the left hand not knowing what the right was doing, and neither being aware of the feet. It was not quite as separatist as this, for they did more or less keep to the same heights and cornices, and the inside elevation is uniform. Yet if their deepest thinking was not based on parts rather than wholes, how can we explain the different treatments given to the aisle windows of the nave and sanctuary only seven years after work began, let alone the multitude of other changes which accumulated from then on?

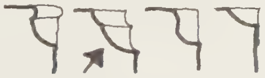
The cathedral was evolved with strict geometric logic, but as it was made of somewhat disimilar parts - twin aisle choir, single aisle nave, narrower transepts - the logic could often distort a part until it was no longer like its partners. As it grew the building tended to become more like a union of increasingly independent parts, and the desire to unify was often over-riden by purely local considerations. To create symmetry across one axis at the expense of the whole, and to do that not just once, but many many times, shows how differently they approached their work compared with our obsession with unity since the Renaissance.

In the EN tower the corners between the square and the octagon are smoothly related through a stone hip that gives a pleasant simplicity and strength to the base of the tower - the work of Ruby. In the south the corners were flattened and extruded into separate pinnacles finishing in crockets which emphasise the change in plan rather than letting it flow from one form into another - the work of Olive. The pinnacles do not allow your eye to flow from the square to the octagon, but like a flower it extrudes one form from the opened calyx of the other.

The confusion has been disentangled in the drawings, and in the other clues which are footnoted. Complex as it is, the main lines are clear enough, and though some parts could have been attributed to more than one crew, the more important are quite firm. It shows how careful we need to be to analyse every discrepancy, for in nearly every case it will lead us to a change in masters. But we are still left with the problem of apportioning each part to a team. Finding joints is like finding the haystack, but getting the identities right is like producing the needle. In this area we do have a number of unmistakable items, like the corbels from Bronze, Cobalt and Ruby, and windows from Rose and Bronze, and we can work either way from them. I must say that Chartres is remarkable and fortunate in the number of these key items left throughout the building. I do not know of any other medieval building which is so well endowed.

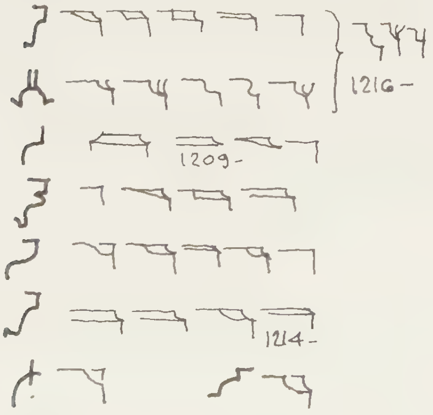
As well as corbels we can work from the different

21. Here are the corner cuts to the tori by the Ruby-ex-Rose gang - XIII:47. The one discussed in n.22 is arrowed.

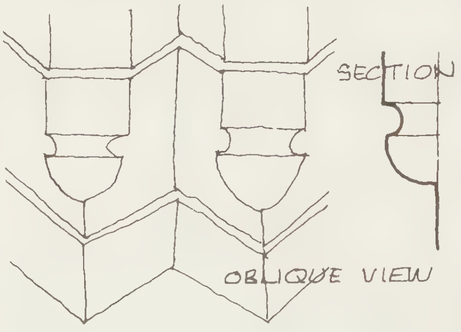


22. Choir (t) - XIII:32/II.j.
Arcade outside SW(t) room - XIII:59
ES(cw) tori - n.8
SW(cw) tori - n.26/g.

23. I here chart the methods used by each crew for joining the round moulding of the torus to the square base. Some run a continuous groove, some cut corners. I have illustrated only the main types used by each master. Where the pattern seems to change I have indicated the dates. This is not meant to be a complete analysis, but only an indication of types. A more thorough investigation should show the modifications made to each shape over the years, perhaps trying to pin-point the gangs who worked on them. However, not much can be read from these methods taken on their own, for we usually need other information, such as coursing heights, joint positions, stone quality and the 'feel' of the torus. Once the basic investigation has been made these grooves and cuts are useful for apportioning bases to already-known teams. The reverse process is seldom advisable.



24. Noted on the section in n.8/j. The splays are cut from 325mm stones. The flyer buttress was thickened by Cobalt as he laid the 3-foil gussets over the arch, shown in n.8/f and see XVIII:45, 58. The vertical joints against the bases are clear in the EN. Notice how often the Ruby/Rose combination formed their reveals with more than one step, and then splayed off the corners - crypt windows, nave aisle windows, east side transept windows, and here - VI:49 and 73/S; X:13; XII:42/f and XVIII:70.



25. When Bronze was placing the corbels over the ES(cw) door he was at the same time laying the arches over the SW colonnettes, in 1222. This shows how much higher the apsidal towers were compared to the transepts. As I showed in n.15 the eastern towers were below the level of the choir clerestory walls, and these were below the nave's. Later I can show in more detail that the nave roof was being finished at the same time, and that the roses round the choir were about to be erected. But in the north the same master was only just finishing the doors out of the tower rooms at the triforium level! To visualise the state of the works at this point I suggest you refer to the Isometrics after ch. XIX.

26. *South transept tower set-out (cw).*
a. The cornice on the north of the SE tower is by Jade-b, built after his arches over the colonnettes. The cornice was finished by Bronze with slightly altered dimensions along the splayed section. Bronze's work included some of the cornices round the SE tower, and all of them round the SW - XIII:54 and 62.

The Jade cornice could have been designed by modules of 23.3mm. The modular arrangement in **m** is self-explanatory. Indealised dimensions are given, and the actual in brackets. If each module was 1″ his foot will be the Sumerian of 280.4mm, and this seems to be confirmed in GEOM:XIV-C.

b. When he built the roof over the SE room Jade also laid out the plan for the tower walls in the SE. Bronze radically altered the plan - GEOM:XIV-D. Jade's plan included shafts in the corners to support the geometries for the towers, the aedicules discussed in the last chapter, and the pattern of plinths and tori. Happily one torus has a most individual splay on the corner, made of two drooping scallops.[21] There is another one of these in the choir triforium, and others in the southern towers and in the arcade outside the SW room.[22] Only Ruby could have done them all in such disimilar places. The other tori in the ES tower are also his, with a rounded upper edge to the corner. A similar base lies over the lintel to the EN tower door, so this is also by Ruby in a later campaign.

Each crew has a distinctive way of handling these tori, and, as on the ground floor, they are most simply followed in the way the ring of the torus is joined to the square block underneath. I have here gathered together all the evidence I have on the tori from all parts of the building, and I have arranged it as an easy reference.[23] It includes the triforium arcade, the ground floor, the clerestory walkway, the flyers and the roof. It shows that some crews like Bronze maintained a constant approach for forty years, while others have changed their pattern: changed perhaps with a new master, or with new cutters or even with an alteration in the ideas of the one master. As these changes can sometimes be dated they may help us to fix campaigns in other monuments.

On the north side of the ES tower, the side closest to the choir, the shafts around the openings have been replaced with a series of steps and splays finishing at the bottom with the same curved section and rib we had found in Ruby's work earlier in the job.[24] They are carved into the same stone as his tori, so the one element has helped confirm the attribution of the other. In this way I have linked part to part, and gradually built up an understanding of these towers. We must now move back to the south transept, for by examining what the same crews were doing there we will be able to confirm the work in the east.[25]

The use of colonnettes round the southern towers naturally altered the way the towers were begun, for in capping the colonnettes they created a horizontal band of arches and over that a heavy cornice to visually 'hold it down'. The light solution which Scarlet had begun in the east would have looked truncated in the south. The new master Jade began the cornice, and over it the continuous plinth course which made the base of the tower even more assertive. By making the same careful observations as in the eastern towers these courses can be divided up like this.[26]

The outside of the two south towers look alike, yet their plans are quite different. The eastern one has a band of walling forming a square, and around this the master drew a diamond which determined the splays in the corners. It is regular and unexceptional. But in the west the corners are warped in the most curious manner which

ribs, as had been used in the north-east corner. Jade built a plinth for only one of them shown in n.30. Thereafter all such shafts were eliminated. This is clearly the decision of Bronze, which he and Green repeated some years later in the north.

c. The continuous plinths were begun by Jade, and works to his modular geometry **n** which embraces the whole of the tower wall. Notice the angle of setback is continuous over both courses, shown dotted. This setback meets the one on the opposite side very close to the tower vault: was this intentional? Just as the 23mm reduction in the cornice course is important in the geometry, so is the setback in the plinth, for the walls of the tower proper, T, rise from it. The RL's of these courses and of the impost over the colonnettes are shown to one side, though the latter is not accurate. By measuring small changes in the dimensions of the plinth course I have distributed them as shown on the plan. This technique may not be justified, though the arrangement is sensible, especially at 'd'.

d. Olive's plinth coincides with the outside plan of the SE(cw) door. The position of the joint is unmistakeable at the threshold, which is in the same stone as the plinth - n.27 - from which I aver that the inner side of the door is Bronze-c, and here he shapes his lobby to suit his door swing as in n.9.

e. SW(cw) door starts in the centre course over the torus, not in the plinth course as in the SE. It is by Rose-e, with his characteristic tori nearby - n.27.

f. Olive's tori have small corner cuts, and are usually 390-400mm high. The south side of the SE tower is an exception, for the plinth course was raised 20mm, and so Olive reduced his tori to 360-70mm. On the north side of the SE the joint is obvious, for the torus overhangs the plinth at one end and at the other does not coincide with the end of the moulding in the plinth - n.29/i.

g. Mixture of Olive and Rose tori.

h. Tori were added alongside some piers. On the north side of the SW tower they are different to the others. Rose?

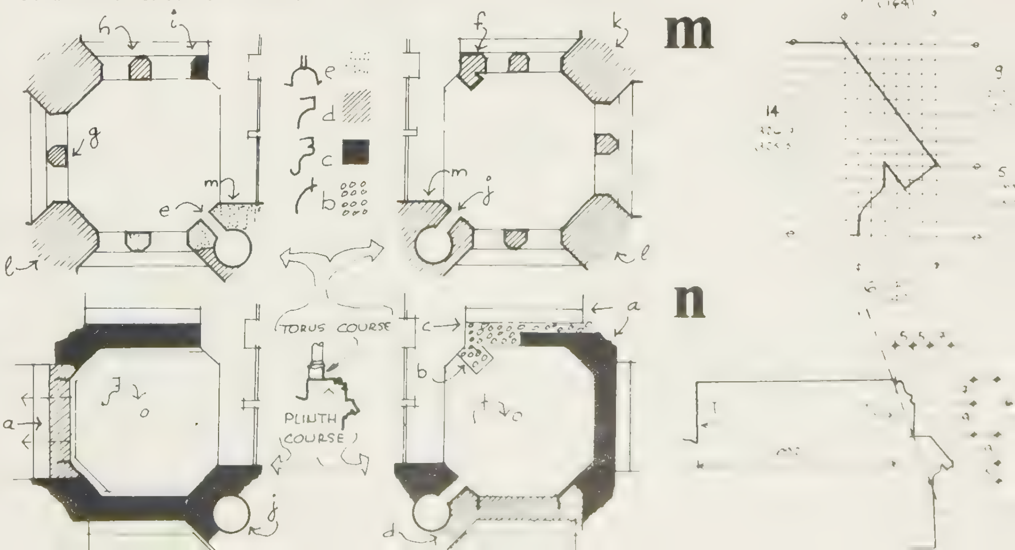
i. The first torus in the SW is damaged, but the groove under it suggests it was by Bronze. As this is the only base which suits his geometry (as contained in the course underneath) I do not hesitate - GEOM: XIV-D.

j. Bronze's double treads in the stairs help show the limits of his work - XIII:51.

k. For the ne. corner of the SE tower and the buttress see XIII:18.

l. Olive did some of the bases under the upper level of colonnettes in the east, and Rose in the west. The decision to continue them was implied in the cornice and the plinth, both Bronze-a. But really there was little choice in the matter, for if the upper buttress had been enlarged the towers would have looked top-heavy, while if they had been reduced with splays over the cornice the colonnettes around the triforium level would have appeared as a horizontal band, rather than as part of a vertical movement.

m. There is a change in the angle of the wall by the SE stair. At the level of the tower roof it shows the join between Ruby, Jade and Bronze - XIII:3 and GEOM:XIV-C -and in the SW there is a similar change at the level of the drain showing the join between Jade and Bronze.



give it a strange shape from the inside. Not that this disturbs the exhilarating feeling I get every time I enter its space. With the marvellous view over the town you feel like a bird in its nest on the edge of a cliff. When the sun is shining and the heat pours through its arches it is one of the most tranquil places on earth. Perhaps those crazy angles do have something to do with it after all.

The regular SE tower was estalbished by Jade at the same time as he built the roof over the room. But in the SW he was working at a lower level, so the roof was laid by Bronze. Though he had to follow the cornice and plinth system Jade had begun in the SE, the rest of the tower is almost wholly a Bronze creation.

In the back corner of Jade's tower there is a shaft which supports one of the vault ribs. It is the only rib in either of the southern towers to be supported from the floor - the others rest on corbels. They cap the space, rather than being an integral part of it. The base is Jade's, no doubt following the ideas which had already been started in the apsidal towers. I presume that in the other corners Jade would have begun shafts over the stones which now form the splay of the diamond, except that Bronze carried them up plain. The unsupported rib is a Bronze device. He had had nothing to do with the eastern towers, just as their two designers, Cobalt and Scarlet had had nothing to do with the south. It would be worth while following the four geometries in this chapter for they give four quite different solutions for tower designs.

In the next course later masters modified the plan again, as can be seen where the base of the shafts laps over the plinth. The SE door was begun by Bronze, but was changed on the outer side by Olive,[27] while the SW

Geometry XIV-C

The layout of the SE tower by Jade, 1221.

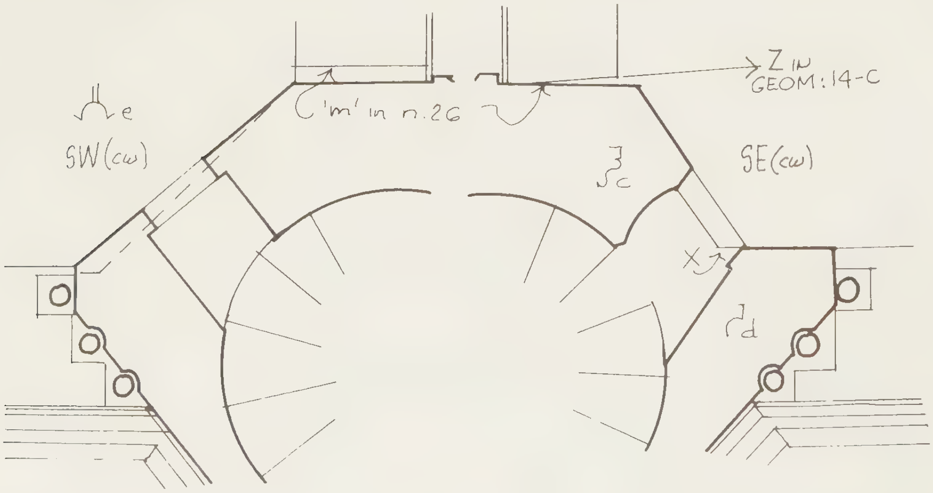
Jade had not worked at Chartres before. As this was his first appearance here he had a lot to learn, and it seems that in working out how to build the southern towers he analysed each one separately, without trying to link one to the other across the space of the transepts. He may have thought of dividing the facade into seven parts, but then the space between the triforium walls would have been too small by 115mm, and there are half a dozen other possibilities which miss out by the same amount. As I have not yet found an overall geometry I have assumed that he resolved each one independently on the facade.

He combined squares and hexagons into a sequence of figures. He began in **l** from the bay as measured from the shaft S to the stringline between the SW.III and the SE.III buttresses E, which are 7,570mm apart, and which measures 27^{SF}, which is Jade's foot of 280.4mm. He increased this through the hexagon in **n** set inside the previous one to locate the inner faces of these walls, and this distance is the same as the space between the shafts supporting the ribs of the high vaults in the adjoinging transept bays.

In **m** there is a similar figure emerging from the axes S and F. The first axis is the same as before, but F is the axis from the arcade piers on the ground floor. From them, using the same hexagonal construction, he located two of the axes through the tower rib shafts R. The axes N the other way in **o** come from the next hexagon within that. Thus the voids within the tower represent the ratio of $2:\sqrt{3}$. The diamond outside that circle located the exterior face of the plinth under the tower walls M, and they turned out to be precisely 32^{SF} apart. This plinth and its outside moulding is shown in n.26.

Lastly in **n** the splayed corners inside the tower and the plinth under the one remaining rib shaft lie along the sides of the diamond which relates to the SE axes. Thus the rib shafts are derived from the ground floor axes SF, and the wall structure from the buttress axes SE. The diamonds based on each of these pairs of axes locate the splays under the rib shafts and the plinth under the walls, so the supports for both aspects of the tower structure, wall and shaft, are derived in the same consistent way from each set of axes. In this respect the plinth links together the two systems.

However the layout is not as simple as that, for the centre of the tower does not coincide



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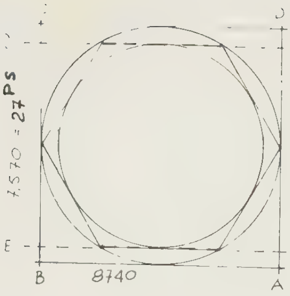
[27] The SE door was begun by Bronze, and there is no way of knowing what the rest of his geometry would have been. Just note that the master who was most likely to cut an arc in his lintels for a door-swing was also most likely to do the same in his walls - n.9. The present width of the door is almost 2^{TF} and the jamb and threshold are cut from the one stone with a splay cut at one end X. Inside that the stone work is ragged. The south jamb is cut at a different angle in a stone which includes Olive's plinth, and above that one of his tori - n.26/d.

The SW door lies above the tori, which are by Rose - n.26/g. The plan is the same as he had used in the EN.III(t) gable - XII:38/IV.c and described in IX:30. The drain to Bronze's roof, shown dotted, suggests he had intended to place this wall on a different line -GEOM:XIV-D.

l



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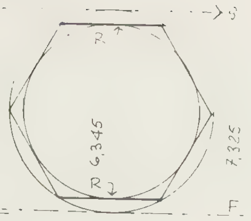

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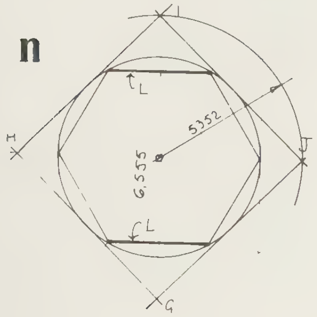

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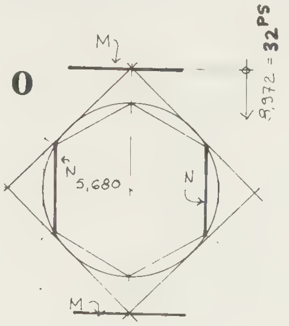
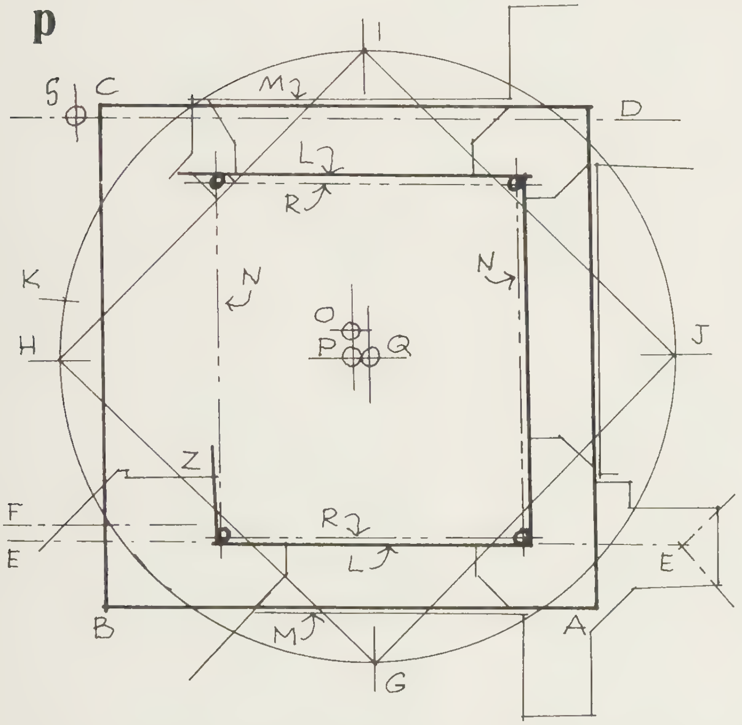


p



with either pair of axes, but is well to the south of them. The reconciliation of these centres, and the way he has evolved them step by step is an excellent indication of the skill of the master, and the careful logic applied to the resolution of each part.

The sequence of hexagons and squares just described were still derived from one another, but in fact they were arranged around three centres, not one as shown in the earlier drawings. This is described in **p.** Jade began with the axes through the shaft S and the buttress epicentre E. His hexagon increased this for the tower box ABCD, and first located the eastern and western walls BC and AD by sitting the former over the triforium wall already built on the inside. This positioned the first centre at O, and O lies *precisely* over the centre of the aisle established by Bronze in 1198, see GEOM:III-A. The accuracy of medieval building is quite extraordinary.

In the other direction the box would have to be slid to the south if it was to lie over the room below. This located the second centre P, which was on the same north-south axis, but was displaced 560mm, or just 2^{SF}, to the south. It seems remarkable that he was able to do both these things, to suit the building underneath, and to arrange the centres through his foot.

From P he drew a circle with the diameter of the distance between the ground floor SF axes of 7,325mm, and within that he drew the hexagon that located the east-west axes through the rib shaft R of 6,345mm. The diamond around that produced the exterior face of the plinths M at 8,970mm apart.

The walls behind the shafts L come from the hexagon within that of the ABCD box, again centred on P, forming an interior:exterior ratio within the box of 3:4.

Both of these interior dimensions, the rib axes R and the wall faces L, were then each reduced by the hexagon to locate their eastern and western boundaries. These rectangles were then moved eastwards until the wall coincided with the inside of the eastern plinth. This positioned the third centre Q.

PQ measures 437mm, or one twentieth of AB! while QD equalled the oft-used one tenth of the typical bay. From Q he constructed the large circle GHIJ as $\sqrt{2}$ of the SE axes, earlier drawn in **n.** In this move he returned to the first part of the setout. Within this circle he constructed the diamond that located the internal corner splays and the face of the plinth under the remaining rib shaft. He did not set this diamond square to the axes as he had in all the other parts, but square to the eastern wall which, in the stiffening action these splays have, in a way reconciled the inclined walls with the true axes.

Remember he was working high in the air, so how did he draw this circle? How did he extend these lines into space? Or did he have to have a special platform built around the tower at the level of the cornice to let him work out his geometry? Bears some thinking about.

I would expect that if he had stayed longer on the job he would have continued the plinth courses on the inside, and would have placed the other rib shafts' bases over them as Scarlet had in the EN tower. Maybe his sense of symmetry was different to Bronze's who came after him, as he may have been seeking an arrangement that would be more sympathetic to the layout for the apsidal towers than was to be built later.

On the inside of this figure he made an adjustment. As the centre of the clerestory window is to the north of Q at K, he shifted the point of the diamond H to the north until it lay on the middle of the window at K. On the north is passed behind the rib shaft (which is why it is not expressed there), but on the south it precisely meets the intersection of the north wall of the stairs (below the level of the roof, being 'm' in n.26, and drawn in n.27) and the interior wall of the tower at Z. This is why in XIII:3 I attributed the lower part of this staircase wall to Jade, for it is angled differently to the upper part above the roof line.

After fixing this intersection I imagine he would have located the other face of the stair enclosure along the west side of the tower, and that his doorway would have been organised to the side of the rib shaft. This is as much as I can extract from Jade's very beautiful scheme. Bronze continued this arrangement, though he went his own way around the stairs, and then Olive redesigned the openings and moved the northern shafts 110mm northwards so his tori overhung the plinth. By doing this he established another tower box measuring 8,850mm each way, which on the inside of the clerestory passes through the centre of the responds rather than along the face of the wall. Olive here rectified Jade's omission by relating the rest of the towers to the south facade in a ratio of 7:10:7 (8,850:12,645:8,850mm).

...XIV-A & B/*/XIV-D & E/XX-A...

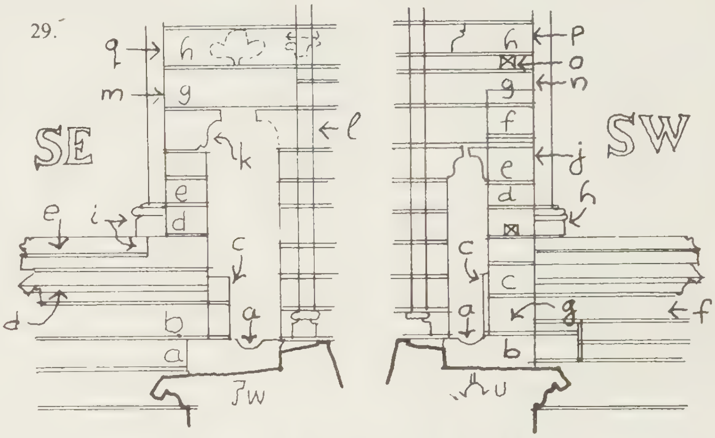
one has little affinity with the east, but is like the one Rose had carved out of the north sanctury gable roofs. But once we reach the level of the corbels, both doors were finished by the same master, Bronze.[28]

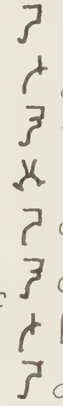
For a further demonstration of this order of crews look at the openings at the other side of the towers from the clerestory walkway.[29] The work of Jade, Ruby and Bronze in the lowest courses of the towers is clear enough. Ruby had begun a small pilaster on one side, and this was continued by the next few masters to the corbels, which are Rose's in the SW. But in the next course the pilaster is capped off with a sloping cover, and the course above that forms the capital to the high vault on the inside. In the fourth course the shape of the buttress was even further simplified. There are four changes to the geometry in four courses.[30]

On the other side Rose carved another corbel over the opening, but it has been buried into the wall, so that its bottom mould disappears into the mortar. This makes it look more like one that Jade would have carved. There seems to be another Jade corbel opposite it, but when you scrutinise it carefully you will see that the underside has been roughly chopped back.[31] The careful edging at X and Y has been angled slightly to the rest of the curve, and in contrast to the other surfaces of the stone, has been cut with a chisel. I copied it full-size onto a sheet of cardboard, and set it against other corbels in the building. Then I had no doubts - it had once been a Bronze, and his original shape is shown dotted.[32] It had later been hacked back to remove the two roll -mouldings so that it looked more like a Jade. Most suspicious.

I think it can be reconstructed this way: Rose began carving his corbel but did not finish the stone. He would have set it lower down, into the course immediately above the torus moulds of the tower as he had in the west. Then Bronze came, and raised the height of the opening. He set Rose's stone to one side, and began carving his own

29.





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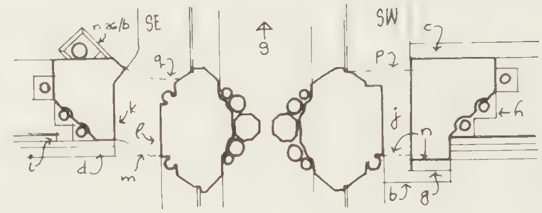

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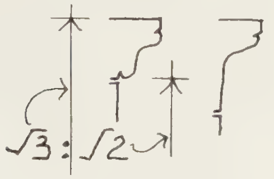
28. Bronze corbels usually form $\sqrt{2}:\sqrt{3}$ ratios based on 6^{TF}, unrelated to door widths. Here for the first time we find a variation on the Bronze corbel - shown on the right. The bottom roll has been eliminated. The date is 1225. They are installed with his double treads which has been one of Bronze's characteristics since 1217 - XIII:51.



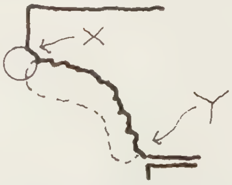
29. *The opening into the south towers seen from the north.*

The pace of work may have been reduced here, as can be seen in the isometrics, as a way through the clerestory was needed for materials being transported from the nave and choir cranes to the south terminal wall. See XVII:22 for a similar example.

a. The drains at the level of the clerestory sill - section XIII:3. Ruby in the east, Jade in the west - XIII:54.
b. The Jade drain in the SW was enlarged to support a pilaster to strengthen the pier. He fixed a narrow opening here instead of the wider one begun by Ruby in the SE (to his standard door width - XIII:7/n.).
c. The tower roofs are by Jade and Bronze respectively. Jade sloped his to the inside without any drains around the perimeter, while Bronze cut a drain all round the roof, pitched the stones to it and discharged the rainwater out of spouts, this is shown on the plan n.26. The extra height of the SW roof was determined by the cells underneath, not by the roof construction - XIII:53.
d. Cornice and plinth by Jade, see east elevation XIII:18. Cornice section n.26/m.
e. Plinth above cornice by Jade in SW, finished by Bronze and Olive - n.26.
f. Upper part of SW wall Bronze-c with his arches over the colonnettes - XIII:62.
g. First stone of pilaster could only be Bronze, for it is smaller than Jade had intended in the upstand on his drain.
h. Only torus by Bronze? - n.26/m. Notice putlock hole.
i. First of Olive's tori in SE and notice that the moulding of Jade's plinth was stopped off for a larger pier - (see the plan in n.30) - n.26/b.
j. Rose-c corbels, cut for and laid in the SW.
k. Another Rose corbel, but laid by Jade two years later. He raised the passage lintel, and pushed the stone inwards so it would resemble on of his own.
l. Bronze-c corbel cut for here, but altered by Jade - see text.
m. The shape of the buttress was changed from what was intended by either of the earlier masters. It was done with the cap under the vault spring by Jade. This cap was cut for a circular shaft, yet it should have been octagonal - shows a team with no previous experience on this job - XVIII:53/e.
n. The vault cap on the other side is also by Jade. He finished the capping to the pilaster which he had previewed in his earlier drain, but as its angle changes under this stone I have donated the one below to Bronze. This is discussed in the text and n.31.
o. Putlock hole in the cap impost course.
p. The buttress shape was changed again, with a moulding like the one Rose used over the ES(cw) lintel - n.14/j. See n.31 for plans. Swapping gangs again?
q. The SE buttress was also changed, and the respond on the inside capped off with a massive leaf like Rose-*Cup* XI:14/1.

30. The changes in plan to SE.II and SW.II buttresses are drawn from the same direction as the elevation in n.29 with east to the left. Each change, here as elsewhere, shows a change in masters. The thin dotted lines are corbels, the thicker ones are the courses over them, with references to the previous note.

31.



32. Follows the silhouette of NW.II(cw) and the smaller SE.III(t)-S and NE.II(t).

33. GEOM:XIX-C.

corbel for the east face but did not put it in place. When Jade arrived he found the partly cut Rose corbel, and the unplaced one by Bronze which only needed slight modifications to be placed as his own. He then carved the capitals for the vault and above that slightly altered the shape of the buttress. There is not much sympathy for a supplanted team is there?

We have now accumulated enough pieces of information from these very interesting but difficult areas to isolate with some certainty the teams between 1209 and 1226. It has taken three chapters, but has set the stage for the more important analysis of the clerestory. We have spanned many years, and have not seen much done in the towers, yet the Rose who had his corbel so unceremoniously modified by later men had just finished the high vault over the crossing.[33] Some of the

Geometry XIV-D

The SW tower layout by Bronze and Olive, 1222-3.

Bronze designed more through openings and axes, than through masses. He liked to arrange these parts properly, and then let the solids take care of themselves. He located the axes first and then the space between them, but he did not work directly to the solid/void proportions of Jade or Olive, nor for that matter to those of Cobalt or Scarlet in the eastern towers. We have already met his approach in his windows, and in the spaces he organised between the arcade piers - n.13 and GEOM:XI-A.

The curiously irregular look of this tower with its oddly splayed sides has no counterpart in the other towers. The geometry began with the axes shown in fine dashed lines, which encase the tower from the buttress epicentres. Notice how the northern one S bends at each end of the tower. The distance between the towers is 44^{TF} across the transept (locating the eastern tower axis X), and within the tower they are almost the same as the ones he had begun on the ground floor 24 years before of 22^{TF} - GEOM:III-C. But in fact the tower axes, predetermined by the buttresses placed by Cobalt and Red over the triforium walkways, are 30mm less than 22^{TF} apart, which was no more than 1mm per foot. Yet in organising the other dimensions in the tower Bronze did not attempt to fudge this 30mm, but he applied the proportions he would have used in feet to the actual sizes as he found them.

The interior space of the tower was made 20/22 of SE, measured across the middle of the tower at 6,709mm. The exterior face of the tower walls W was made 6/5 of the true 22^{TF} he had used in the lower axes, at 8,890mm. The thickness of the wall that resulted was 1,091mm, though at 1,089mm it could have been derived as $2^{TF} x \varphi$.

The exterior face of the plinths which project past the walls enlarges the W square to 9,150mm, and this coincides with the walls under the towers which had been finalised by Bronze in an earlier campaign: in 1217 when he began the arch on the western side of the tower room, XIII:57. This dimension also came from the SE axes, by his favourite $2/\varphi$.

The position of Bronze's only torus moulding in the north-east corner locates the inner shaft axis Y. The square so formed would have measured 7,275mm, which is 9/11 of the W box. East-west this located the western face of the clerestory mullion and its attendant window frame.

I have presumed that the sides of Bronze's openings would have been located where the internal splays met the inside of the tower walls. They form a consistent geometry which seems to justify the assumption. On the north the opening was placed centrally between the eastern side of the pier A and the corner of the western buttress B. The southern opening was placed centrally between the point where the line of the high vault rib intersects the Y axis at H, and the other point where this axis meets the next at Z. Lastly the western opening was placed central to the buttress axes CD. The width of these openings would then have been half the distance between the SE axes, or almost 11^{TF}, and are shaded.

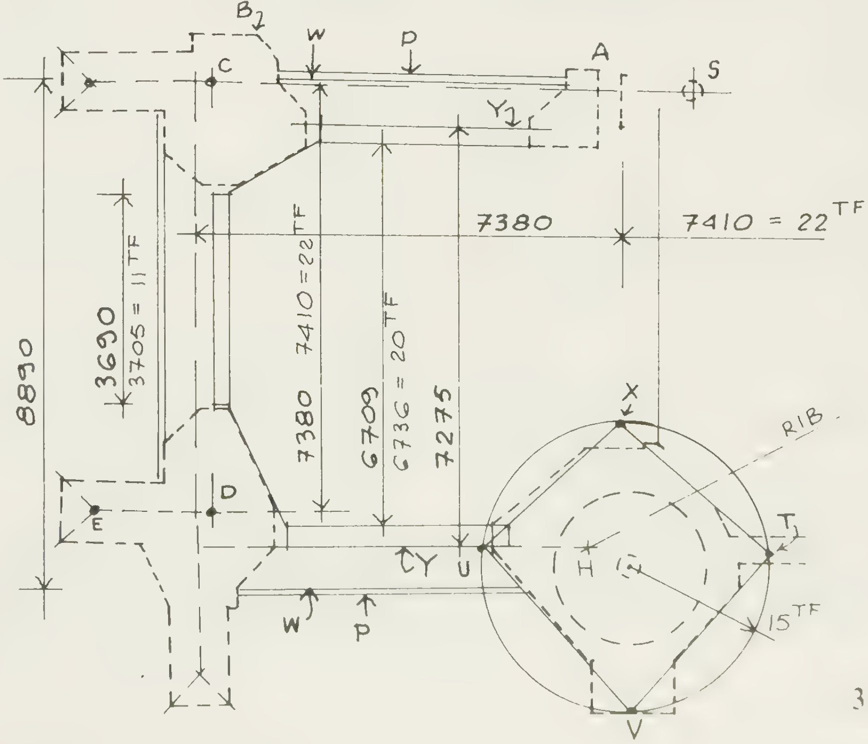
The stair buttress does not at first glance fit into this geometry. But once I had located the joints between Bronze and Olive I found where the latter had made a few small changes. Olive's outline is shown in bold dashed lines, while Bronze's intentions are shown in lighter unbroken ones. Olive had moved the centre of the southern opening to the west, hence extending the projection by U. He had slightly altered the splay XU (fortunately the original is visible, being the drain in the lowest course). He also eased over the angle of the splayed wall UV (again the original angle can be followed in the cornice by Bronze).

Once I could redraw the buttress to Bronze's original shape the geometry was obvious. Draw the circle around the buttress from the newell N, with diameter 15^{TF}, and contain all four splays within that. This may not have been how Bronze would have handled the buttress, but once confronted with Olive's outline from GEOM:XIII-C, he had a technique for coping with the problems it raised, and for reconciling a number of unrelated elements, while still maintaining a meaningful enclosure.

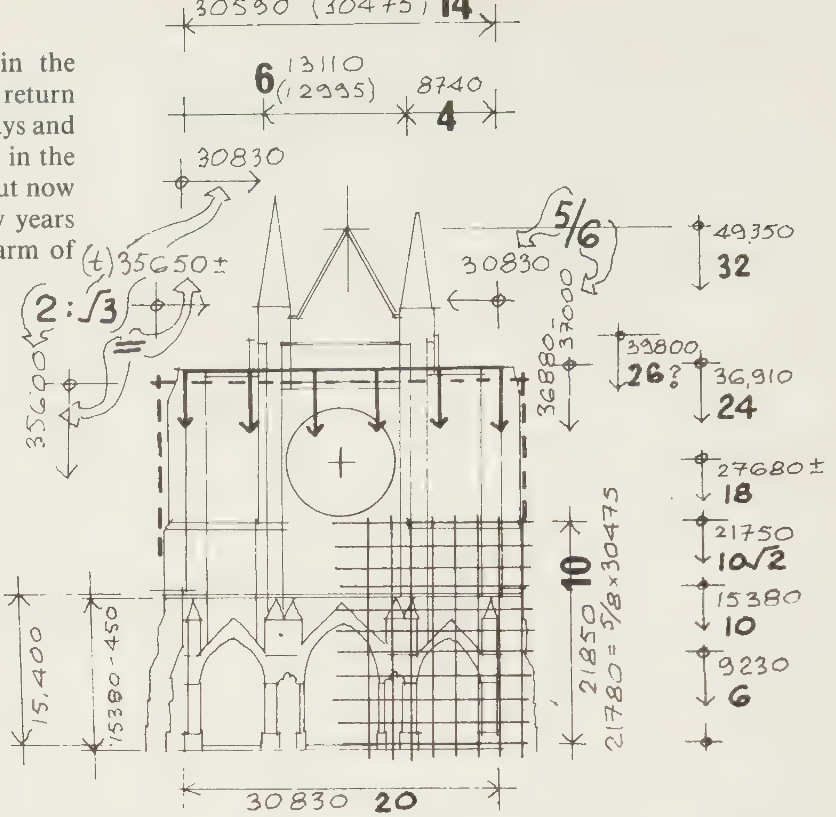
X lies on the tower axis mentioned earlier, T lies on the centre of the wall under the southern rose, U lies on the Y shaft axis, and the two southern sides follow the walls underneath to the centre of the external buttress at V. This left the side XT to find its own place.

Olive modified Bronze's other openings as he had Jade's in the SE, by making them larger, and by shifting their centres. On the north the centre is the same (if only because Bronze had already placed the shafts on the eastern side), on the west he placed it central to the space between the faces of the buttresses along W rather than between their axes, and in the south he placed it centrally between the wall of the stairwell and the side of the SW buttress. These are small adjustments, using wall faces rather than axes, but they have had a big impact on the corners where the splays no longer relate to the shafts between them.

...XIV-A, B & C/*/XX-A...



uncertainties in this analysis will be clarified in the clerestory, but before we can go there we must return many years and look at the north with all of its delays and manifest difficulties. Until we could find an order in the rest there would be no point in venturing into it, but now we can return, almost to the earliest work twenty years before, and examine the last and most intricate arm of the cathedral.



Geometry XIV-E

Possibilities for a vertical geometry on the south facade.

After much experimenting I found that the essential, or base dimension for many elements in the south facade, and from which nearly all the heights could have been taken, is the width of the transept. This is the width across the walls, without any projections like buttresses. Just the plainest and simplest mass.

At the ground line it is 32,170mm, but remember that one wall is thicker than the other, from GEOM:VIII-A & B. Above the aisle window walkway this thickness was adjusted so that both walls became the same thickness at 30,840mm - VI:65. As we have seen in GEOM:XIII-A there are as many variations to this length as there are masters, but they all lie within the range of 30,400 to 31,000, with most of them lying within the dimensions used in the triforium zone of 30,500 to 30,840mm. I shall be using the appropriate length to suit the heights, though the tollerances are now so wide that some relationships may well be coincidental. I will call this dimension the Fundamental. It can be related to the Creation Figure in VIII:58, as 35,334 (which is half the distance from the Labyrinth to the Rondpont, and also the width of the nave walls) x $\sqrt{3}/2$ = 30,600m.

In plan the distance down the axis from the centre of the crossing to the transept wall is 30,840mm, and the other way, measured to the plinths along the terminal wall, is 28,035. They relate as 11:10, being the space as seen by the eye within the walls. The use of the Fundamental across the outside walls as the base for the verticals is like inverting the fact that it is also the interior axial width of the transept. The facade thus represents the void behind it.

This width is the work of Bronze who fixed the eastern wall over the walkway, and it is reflected in the porch too, for above the first horizontal moulding the width of the porch is the Fundamental. Also something similar was implied in Scarlet's first plan, and Scarlet and Bronze are involved in many of the later uses of the Fundamental.

To project this width vertically and to understand its ubiquity we must go back to the work laid before 1210, and forward to the roof tops after 1230. The triforium cornice round the nave was eased up a little as it entered the transept until it became 15,400mm above the floor, or half the Fundament. This was the work of Olive, using a different geometry to Ruby in GEOM:XI-C. Where the cornice passes through the buttress towards the south front it was lowered with a step. This is also the work of Olive, and here the cornice relates to the ground in the same way, but not now to the internal floor, but to the paving level of the porch. This is noted on the left of **r**.

The second major horizontal is the cornice around the clerestory. When Jade reduced the tower's width at the plinth of 8,740mm he also reduced the overall width from the Fundament to 30,475mm. This almost divided the facade into 14 parts, where an imaginary tower block formed 4, and an imaginary inner space formed 6 modules, shown to the right of **r**. See GEOM:XIII-B and XIV-C. I say imaginary because nothing in the facade itself corresponds to these points, as they lie on the inside of the walls. These ratios would only have been possible if he had ignored the fact that the space across the last bay of the transept was 110mm smaller than what he required. He may have taken this into account for the vertical to the tower cornice was calculated from the actual width, rather than from the theoretical. Lastly he may have intended to make the overall width to the outside of the colonnettes around the buttresses 16 modules. I have shown the theoretical dimensions on the elevation, and where they differ significantly to the actual, the latter are in brackets.

At the top of the building the towers were to be capped off with another cornice. This was not to have been the uppermost part of the building, for there are shafts over the cornice making ready for a fourth stage - ch. XIX to XXI. The top of this cornice is just 6/5ths the Fundament, while the lower cornice over the rose relates as $2/\sqrt{3}$, shown in the top left corner. Nearby I have shown that the height of this middle cornice matches the total width of the building to the face of the flanking buttresses from the triforium level upwards, and that it is also the distance from the labyrinth in the nave W.IV to the centre of the rondpont at E.IV.

The tops of the tower vaults coincide with this line, as they do elsewhere, which shows it was important for the top line of the vault and its roof to meet a significant point.

To the far right of the drawing I have shown the vertical grid that may have determined parts of the facade, being a grid of 32 parts by 20. Notice that the sixth coincides with the arcade capital heights inside, and that the triforium cornice lies on the tenth part, and the rose on the 18th. And what of the clerestory, considering how Jade divided the Fundamental into 14 parts? Bronze may have reinterpreted it to suit his grid which divided the Fundamental into 20 parts, by making the clerestory at $\sqrt{2}$ of ten modules.

Many parts of the present facade were definitely not built to this Fundamental, but it sneaks in either as a first thought to be elaborated on later, or as a possibility which may have been used if the right master had been working at the right place. What adds credence to this idea is that the level of the EN(cw) roll mould is exactly 14 modules from the floor. Scarlet built it as the first tower to place its cornice, showing that Jade altered the principle which Scarlet and Bronze had been using. Also each of the 20 modules measures 1,538mm or so, and this is one of the commonest modules to be found in the triforium piers and tower walls in GEOMS:II-C and XII-A.

FIFTEEN

Delays in the north

The man who has been trained from youth in the sciences as well as being practiced in the arts, naturally proves to be the best architect. Geometry is by nature capable of giving substance to many arts, and far from being injured by such use, it simultaneously advances them and in return is honoured and adorned by them.

Pappas

Every part of the north transept reflects the delays it suffered before Peter de Roissy became the Chancellor.[1] The north porch is much more complex than the south, its forms are more varied and the discrepancies in the mouldings more marked. The northern circular stairs are more jumbled and their walls more disturbed than any other part of the building, with broken coursing and other irregularities which inevitably bespeak the idiosyncracies of the many master who worked on it.

The Gothic cathedrals of this period are so constructed that only when the work is above the level of the arcade arches can each arm be raised separately, without needing support from any other arm.[2] The lateral forces produced by the arches and by the triforium must be transferred from one bay to the next until they can be absorbed by the piers of the crossing or by the outside walls. Once this level is completed the thrusts from the much higher levels of the clerestory can be channelled down bay by bay until they meet the transepts. Even those from the arches over the crossing could be transferred to the next bay, and then down the triforium and over the arcade arch to the outside: as long as the transept walls were at least as high as the arcade. It demonstrates that you cannot build a huge multi-storeyed church without the transepts, unless you specially design each section so that the upper works do not push the sides over.[3] Hence as soon as the aisle vaults were ready to receive the loads from the triforium the masters were compelled to erect the last arcade arch and to support it on the terminal wall of the transept, no matter what might be delaying the outside of that wall.

The irregularities of the ashlar within the NW staircase show that at one stage the wall on the inner side had been raised considerably above the outer wall. The reason seems to lie in a serious delay to the N.w doorway. This forced the builders to cope with the thrusts from the arches by raising the inner skin of the wall to support its springing, even though it was then many meters higher than the outer skin which had not yet risen above the level of the lintels.[4]

Causes and their interpretation are usually different from facts. The complexity of the north porch is a fact - just compare it to the south to see this. But the interpretation of these facts is far more difficult. It is based on one's assessment of like things, such as saying that this window looks like that one, or that a buttress uses a particular geometry. No matter how carefully it is done it is in the end one man's interpretation. This is the nature of most historical work, which is what makes it such an open and exciting field of study. But beyond interpretation we like to seek causes, and this is another matter altogether. We can look at the stones and with our intellect conclude that one of the doorways must have been delayed for some years, but we may never really know why. Nevertheless I still intend to speculate, but only after we have looked at the facts.

There are only four places where we can get a clear fix across the building to tie the work of the north into what we know elsewhere. Certainly the lower courses of the stairs, with their doors and windows, are contemporary with Bronze's and Ruby's work in the south porch and in the apse just before 1200. The doorways are also identical to those in the south, and the work of the two masters follows one another in precisely the same way. The work

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1. The delays began after Bronze in 1201, and work recommenced after 1207. Peter de Roissy became Chancellor of the Cathedral Chapter in 1208, and left in 1213. Katzenellenbogen, 1959, p.78.

2. With large solid crossing columns the nave could be built on its own, as long as the side thrust onto the first isolated pier in the transept is taken in some way, perhaps with a tie or a strut. Similarly above the clerestory sill level. Thus by resorting to special tricks, as they did at Soisson, the different arms of the cathedral could be built separately, but the erection of a building in bays, one at a time from floor to vault, is utterly impossible. See drawing and discussion IV:47, and Murray, 1975, who described the problems in strutting the western piers at Troyes.

3. Though the transverse arch over the nave next to the crossing was held together with a wooden tie, the actual thrust emerges from the arch some two meters above this point. Hence the tie cannot be taken as evidence that the nave was vaulted before the transepts were built to this level, for there would have to be something beyond the nave clerestory wall to absorb this thrust - van der Meulen, 1965, p.102. See ch. XVIII.

4. The location of the SE joints does not suggest that the transepts were once in another position, and were later pulled down and re-erected further out. The foundations in the boiler room confirm this - VIII:32. Van der Meulen proposed this theory, 1965, p.110, and 1970.

of these two crews carried out in the same order and to the same templets must establish this.

But even during Ruby's program the work around the north west door had begun to drift, so that the little window NW.21 is quite different to those on the same level in the south. And where we should expect to find a NE.21 there is nothing but a blank wall: the window has been left out.[5] From here on the changes occur thick and fast. Not one of the five internal windows has any affinity with those in the south, and there is nothing, not one single detail in the outworks of the north porch or its piers to remind you of the other side.

The buttresses built above the roofs of the porches follow different patterns,[6] and the windows looking over the north roof are open and generous, quite unlike the tall hungry ones in the south squeezed into the corners. And, as you would expect, once you get to the triforium the rooms, corbels, doors and so on are only incidentally related to those in the south, or to those in the east. However, we can firmly link the masters in the north triforium with work in the south at the level of the clerestory. It is the sequence Jade-Bronze-Olive-and-Rose which includes the uniquely carved trefoil arches with the crazy joints and ball-moulds we discussed at the end of chapter XIII, and which will be taken up again in chapter XVII.

There are many other pointers from there on. It is only below that level that the connections are uncertain, though with two exceptions. One is quite unmistakenly the work of the same crew, and of a crew which only worked once at the cathedral. It is the master Red who carved the supports under the stair treads of the eastern towers.[7] We find a large group of these corbels in the NW stair. Their silhouette and dimensions are the same as in the east. It may have been Red in an earlier campaign, but there is no other evidence whatsoever that Red worked on the cathedral before this date, and precious little thereafter. He seems to have come to the town only once during the main part of the work, perhaps straight from the district round Reims where the same detail was to be used in the new cathedral.[8]

The other exception is a wide door leading onto the roof of the porch just above Red's treads. It is capped with Bronze corbels which are similar to others he carved in his campaign in 1217. Apart from the sequence at each end, and these two major links, there are over a dozen important items and innumerable smaller ones which can be correlated, though only with hindsight. They are not ones I would have had any certainty about if I had not been able to establish these four major links. They are not proofs but, just as important, they confirm the theory. I have lived with the building and its problems for over ten years now, and am convinced of the accuracy of this analysis, though small items may be open to change here and there.

I have already shown that from inside the cathedral we can follow three sets of joints around window NW.27.[9] From within the stairs the coursing shows that its sill was built before the porch lintels, and therefore before the big window facing the outside which looks between them. In the NE stair all three internal windows have the same plan, including the one which looks into the aisle and is the only one of its kind in the cathedral.[10] These windows have no cousins in the south transept.

Since this master built two windows over one another he either did a program of ten courses, or he worked in two programs. The joints within the stairs show it was the latter. Only one crew returned twice to the site during this time without carving windows in the south, and that was Cobalt. These windows are therefore by him, in campaign 'N' in 1207 and in 'S' in 1212 just before Red arrived to carve the supports under the stair treads in the NW stair.[11]

In the NE stair there is a generous opening looking onto the north porch. It sits between the lintels and, as can be seen from the coursing, was built with Cobalt's NE.27. He used pentagonal angles between the inner sides of his interior windows, but reversed the methods on this external one, so that from the outside it is symmetrical.[12] The matching window in the other NW

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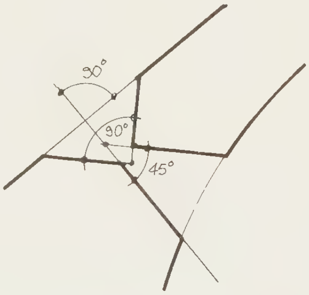
5. The splays of NW.21 are formed from 45° triangles reminiscent of Scarlet in EN.70. Though the window is too small for me to be sure of the geometry, its form is quite unlike Ruby's in the south. There is a vertical joint within the stairs above step 26, with broken coursing on each side, which continues past NW.21 to above NW.27 sill and to the lintel at NW.31. See X:50/n.

In the NE window 21 is missing. The joint steps down on the south side from tread 29 to 25/6 which is below the level of the sill of window 21 in the NW stair. The decision to omit it was taken by Bronze-H, apparent from the stair section n.40.

Of the four windows at tread 17, the NE is the tallest, and was finished by Cobalt-J. The NW is the shortest and was finished by Bronze-H, to a proportion of height to width measured at the widest part of the splay of

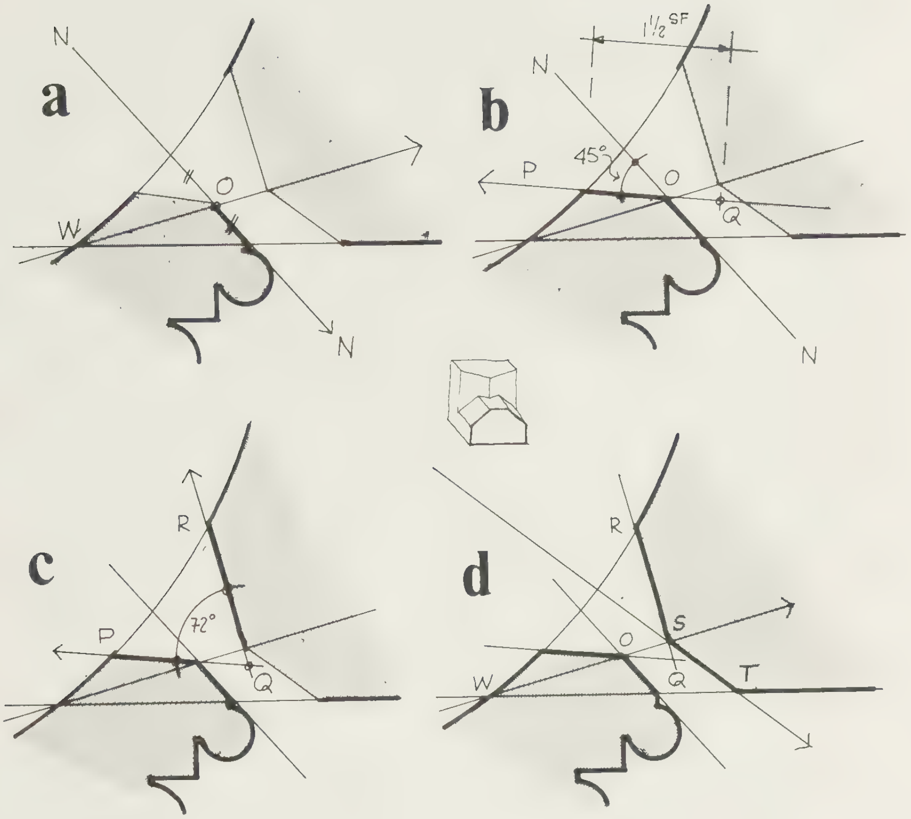


10: $\sqrt{3}$. See n.15/b and n.40. It is important to realise that between campaigns 'F' and 'G' the N.w door had been advanced slightly, and was ahead of all the others. This is shown not only in the windows, but also in the sills in the west wall of the north transept - X:13/G. See relevant isometrics.

6. See their plans in GEOM:III-D and XV-A.

7. XIII:38/r,39, and 41.

8. Reims cathedral was begun in 1210, but the corbels under the stairs would not have been commenced for another 5 or 6 years. There are Red corbels at this level at Reims, though only a close study of the building will determine the links, if any, between them. Other masters could support their treads in this way, as we can see in the Sacristy, VI:38. There are no Red corbels in the NE stair because work had been virtually at a standstill there after the temporary roof was constructed - n.32 - and because the walling was higher than in the west - see isometrics. There are none in the south because the rooms were delayed at this date, most quickly seen in the amount of work by Red in the section XIII:3.

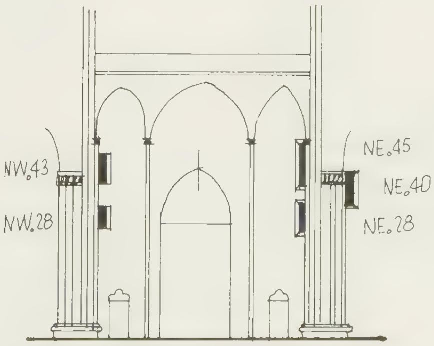


9. IV:7. There are five windows by Cobalt in the north stairs, plus three others whose design was influenced by him. He did none in the south, and only one in the east - ES.55 in X:33. Four of his in the north are facing the interior, and as they are glazed were hard to measure. Fortunately there are enough of them to confirm the geometry.

Draw a stringline from the side of the newell past the small shaft on the inner face of the wall, marked NN in **a**. Along this line divide the thickness of the wall into two equal parts, and form the centre of the window along the string from the wall plane W to O. This is an interesting approach, for the window will illustrate the wall thickness and the point where the wall meets the stairs W. In a way it forms the midline between the spaces on either side of the stonework.

In **b** form the inside splay OP at 45° to NN. Continue this line in the other direction from PO to Q a length of 1½^{SF}, which is his cubit. In **c** form a pentagonal triangle from Q which will give the other inner side QR. Lastly in **d** from where QR cuts the wall centre WO at S draw another string to the centre of the newell, and then extend it outwards to form the other outer side ST. So both outer faces are extensions of the newell - one side from its face and the other from its centre - the solid within the stair fixing the hollow through the wall. Both inner faces reflect the pentagon, while the middle of the window reflects the wall thickness. Sometimes the inner faces have angles slightly less than 72°, I think because in setting out there were cumulative errors, for each side was separately determined from the stringline. The sills of both NW.27 and NE.28 have a flat section in the middle shown on the right, even though the sides of the window meet at a point. The head of the former has a matching flat part, and because sill and head follow this unusual idea I gave the whole opening to Cobalt - n.15. This way of handling the sill is not used later, so it must have left his repertoire between 1203 and 1207.

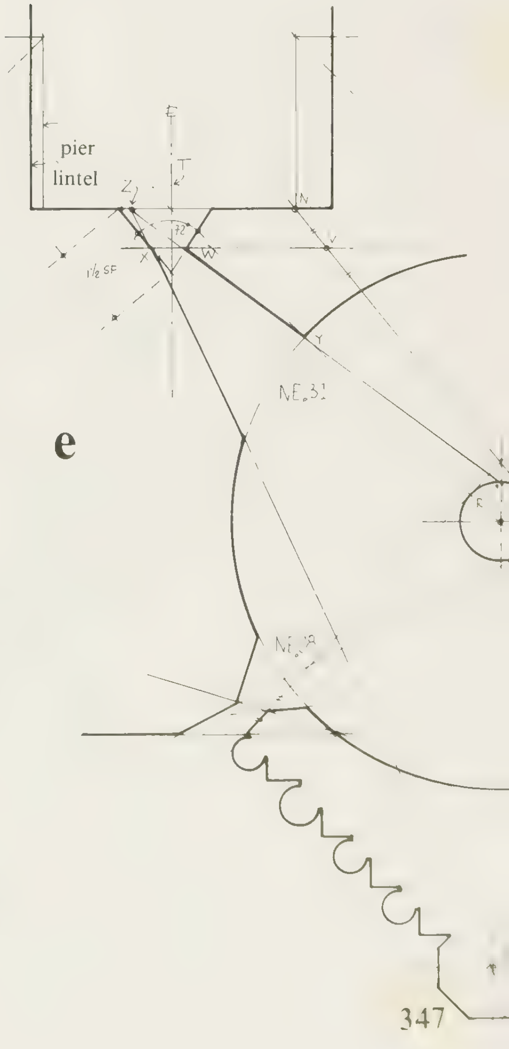
10. Cobalt liked to face his windows into the inside of the building. As none of the internal windows are by Bronze (though he had many opportunities to install them and in the SE stair deliberately left one out that would have matched an earlier one in the SW - p.47) I think we can say that he preferred not to use them. Similarly as there are no Cobalt windows in the south stairs facing inwards I can only deduce that he could not have been working at levels which would have allowed him to insert the necessary sill, and the elevation in X:48 confirms this. This logic helped to determine places where Bronze and Cobalt *could not* have worked.



11. XIII:41 etc, and n.15.

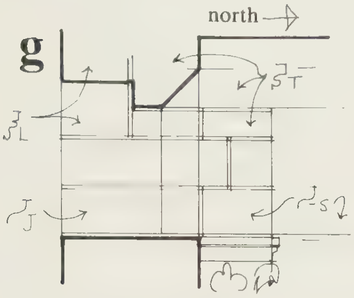
12. The layout for NE.31 begins in the centre of the space between the piers T, rather than that between the lintels, which is different - lintels often being offset from the supports, especially in the north. In **e** form around this centre a pentagonal triangle, with sides measuring 1½^{SF}. The centre of the window will be formed similarly to the last one in n.9, by drawing the string line from the corner of the pier to the side of the newell, marked NN, and dividing the depth of the wall along this string at V, and then using the line from V to mark the centre of the window at W and X.

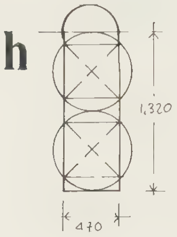
The inside faces could have been formed in a number of ways. Firstly by joining W and X to R and S on the main pier axis. The junction to the shaft S seems reasonable, but the other is a bit arbitrary. Alternatively T could have been joined to the centre of the newell N, and the inner side WY formed from where TN met the stairwell at Y. If RYW is extended back to the wallface at Z, the other side could have been found from ZX towards S. This is just another



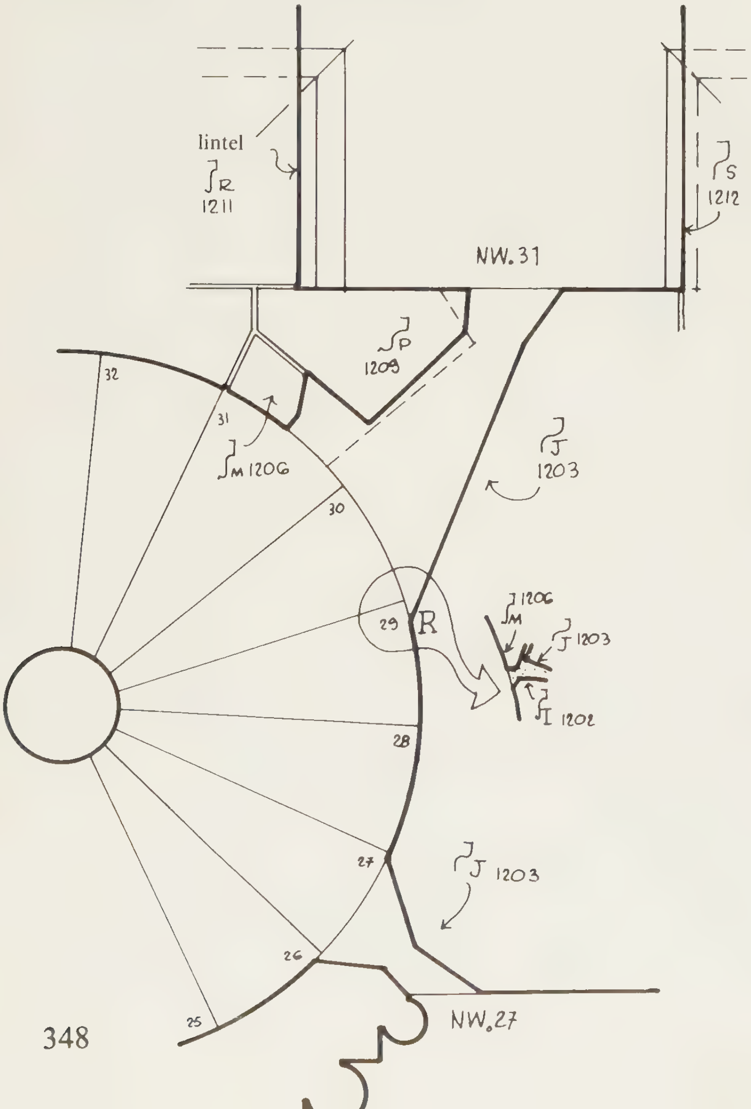
way of saying that I have not solved this one.

In the section through the window **g** the inside head is higher than the outside, probably the work of Bronze, and formed a 3:1 ratio with the width of the outside. However, he could not finish the head as the N.c-e lintel was not laid for some time, n.24. When it was laid it was lowered to suit another geometry: this time using $\sqrt{2}$s as in **h.** This stone was laid with the arches between the lintels, and both seem to have been the work of Red-T - XVI:38. It is the only slot window in this cathedral with an arched head.





13. The east side of NW.31 was set out by Cobalt as a mirrored image of NE.31. The shape the other side would have taken to complete that window is shown dashed. The actual plan of the western side is like the window Scarlet built in SW.64, with the angle between the sides of one interchangeable with



stair is also large, and on one side the shape is the same as in the NE. But on the other it is quite different.

It is a rather peculiar window as you can see in the photograph. The sill seems to have been filled in and raised on the inside, and on the left there is a post. The post supports an inner lintel, but under and inside that there is a second lintel which seems to lean to one side. All the stones roundabout are messy, the joints uneven and there are signs of changes in every course. Look closely at this plan.[13] On the right corner R there is a stone in the lowest course which is chamfered as if it had been designed to begin a window of a different shape. It is shown in the detail. In elevation this stone passes underneath Cobalt's NW.27 window and there is a broken joint between them. Presumably then, the stones over this one and adjoining the inner window are Cobalt's, and the lower one with the splay is Ruby-I. The courses over Ruby's not only include Cobalt's NW.27 window, but continue into the eastern side of the outside window with exactly the same plan as the big one he built in the NE stair.

I have drawn dotted the shape the western side would have followed if Cobalt had continued it. However it was left unfinished for six years until Scarlet returned to the job in 1209. Six years for one window? Consider the isometric sketch.[14] Ruby's corner stone R has been almost completely covered up with a new sill butting into it, raising the height of the sill and obscuring his splay. Then on the left there is a post P made of two stones. It is not just an infil for the lintel L sits onto the post with a tight joint showing the post was not put in later. All the western courses of the window were butted into this post, as were all those in the stairwell to the left of it. The post was therefore put up first.

Underneath L there is the second lintel. It is not level for the seating as at different heights on either side. The joint between it and the lintel is large, as if this stone had been pushed in under L at a later date. The drawing makes the reasons clearer, for by putting in the post the upper lintel L could be used to support the course over it T, and this supports treads 46 and 47. Tread 46 was needed to support the wall under the NW.44 window, and that allowed them to build the capital on the inside which supports the arcade arch. The section, complex as it is, may make this clear.[15] Without laying tread 46 the wall over could not have been raised enough to let them finish the arcade inside. Just recall from earlier chapters that Ruby-M who laid this tread was already starting the cross walls in the nave triforium. Though the transept was not far behind, the arches of the end bay on which the stability of the next zone depended were not yet begun. It was imperative to get this section up, and the masters had to act with ingenuity and foresight to do so.

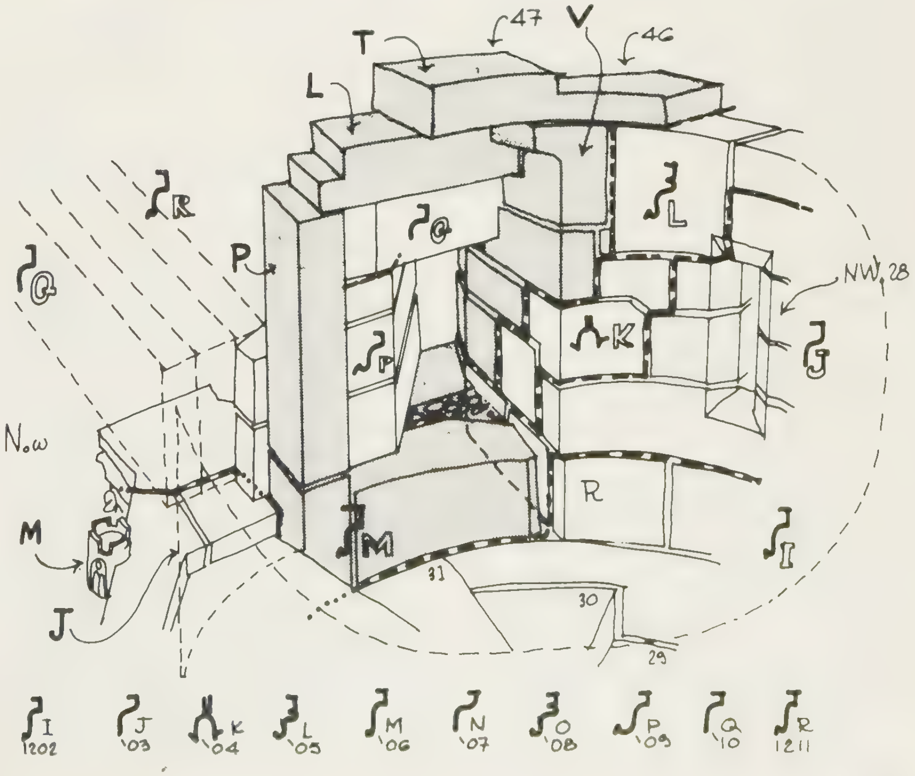
Now return to the sketch 14. Obviously there must have been a hole to the left of the window, otherwise they would have been able to continue the wall all round the stair without these difficulties. The hole lies alongside the N.w doorway, level with its archivaults and the capitals over the large figures in the embrasures. Once I saw that

PHOTO 349: The window from the NW stair at the level of the porch lintels, showing the post and beam supporting tread 46. Some of the broken coursing can be seen on the right.

the other. It seems that Scarlet, who was the later master, did not redesign his part in harmony with what had been already built, but just picked up his old templet and ordered the men to copy it as if the earlier side did not exist! He made no attempt to relate the new side to the old (see n.17 also) - see n.14 for the elevation of this window, and for the problems around its lintels.

14. This sketch of the NW.31 window is taken from inside the stairs, looking down and seeing it as it would have appeared in 1206, except for Scarlet's and Olive's stones around the window. Ruby-M's work with the post P is shaded. All references to the data on which this anlysis is based are recorded in the next note. The treads 46 and 47 sit on top of the uppermost stone T, and are not shown. As the stair descends clockwise, the wall against the inside remains more or less at the same level (shown dashed), until it reaches the N.w tympanum where it drops vertically at J to the level of the treads. A hole extends from this joint J to the post P. The impost moulding M over the canopies was not laid until 1208 by Bronze-O as one of the small turrets carved into it has one of his 'portcullis' windows - XVI:12

15. See this section on the next page.



15. This section of the NW stair is taken from tread 22 to 67, looking from the west. I have twisted the drawing to the left of the window to show what happens on the other side of the post, and to the right I have dotted the courses which lead to the arch over the N.c door. This time Ruby-M's campaign is left unshaded. Read this in conjunction with the other notes on NW.31 and the stair section n.40.

SCARLET-G, 1200

a. Began NW.21 - n.5

BRONZE-H, 1201

b. Continued the walls to the head over NW.17, and probably laid tread 29 - n.5.

RUBY-I, 1202

c. Laid two large courses in the stairs including the start of the window sill - n.13/R. Notice the broken coursing on the right.

COBALT-J, 1203

d. Built NW.27 window with sill and head - n.9. See joint to left of his window head, which steps down to 'f'. His coursing is well-cut.

e. From inside the window the coursing continues along the inside face of the transept wall to the N.c door shown on the right. I have shown the junction of the voussoir discussed in IV:6 and 7.

f. The east side of NW.31 is continued to the edge of the lintel. The latter was to be placed against it much later - n.13 and 24.

ROSE-K, 1204

g. Rougher blocks which look as if they were laid in a hurry.

h. Panel carved on the west of the window, and the adjoining course - XI:14/k.

i. He continued the voussoires over the N.c door with larger stones, as elevated in n.40.

BRONZE-L, 1205

j. Raised the height of the window sill, but to a level lower than that begun by Cobalt on the east side of 'f'.

k. Laid last stone to the head of NW.27, and probably the treads 44 and 45 over it.

RUBY-M, 1206

l. The capital and the canopy on the west were placed with the statue carved by Bronze - XVI:12.

m. On top of this placed the post on the left of the window, and the lintel over to support tread 46 - n.14. Note that the curved corbel on the right of the lintel is the same as he used over the lobbies - X:50/1.

n. Large well-finished stones sit on top of these treads. Notice the joints under and next to window NW.44.

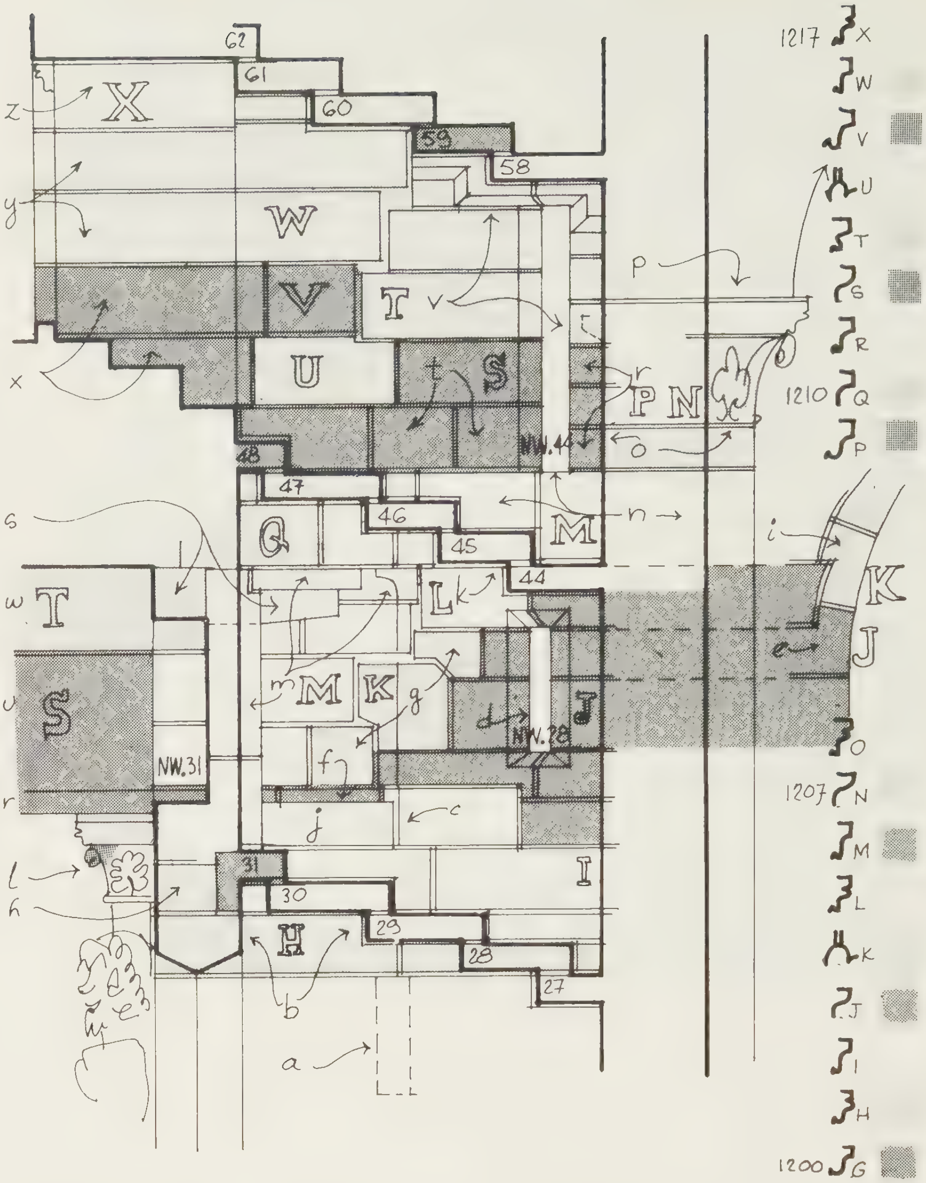
COBALT-N, 1207

o. Continued this walling up to the capital under the arcade arches. Capital was carved by *Stitch* - XI:19. Does not include west side of NW.44.

BRONZE-O, 1208

p. Built the arcade arch over these caps, as in n.19.

q. Laid the last canopy on the east side of the N.w door, marked M in n.14 - XVI:12 - and part of the lintel on the west - n.24. The rest of the lintel against the N.w archivaults is by Olive.



SCARLET-P, 1209

r. One side of NW.44 laid to finish the corner of the pier. Placing a window here saved him from having to continue the walling to the east - n.17.

s. West side of NW.31 window now filled in with stones shown in n.14 butted against the post, and against the lintel. It may have been capped by Olive who inserted the lower lintel.

COBALT-S, 1212

t. Began the other side of NW.44. These courses lie over the three treads which sit over the hole - showing that the earlier teams Olive and Ruby had filled it in. Hence these two finished installing the archivaults over the N.w door.

u. Last lintels on either side of N.c, which being slender were the last to go in - n.24.

RED-T, 1213

v. Finished the top of window NW.44 - n.17. This coincides with his tread supports and the start of the porch door - n.36. You can see here how much higher the work is on the inside.

w. Arches and barrel vault over the space between the lintels - XVI:38/T2.

SCARLET-V, 1215

x. NW(p) door and buttress - n.36 and GEOM:XV-A.

RUBY-W, 1216

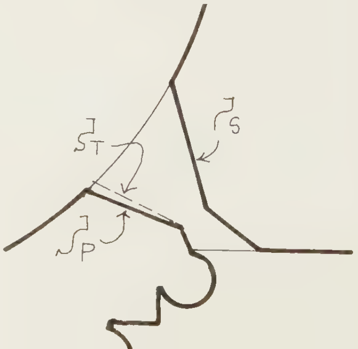
y. Could have done next two courses.

BRONZE-X, 1217

z. Capped the door with corbels and lintel and tread 62 - n.36.

16. For these capitals see XVI:12; for the iconography Katzenellenbogen, 1959; for lintels n.24.

17. Plan of NW.44 showing that the inside was



the sculpture for this door was later than the rest many inconvenient details became explicable - the unusually complex capitals over the statues, the strange iconography, the change in the pattern of the lintels, and so on.[16]

The hole remained until just before Red started, for it was closed in before he laid his tread supports. His band of work is lightly shaded in the section, and fixed the latest date for the completion of the nearby sculpture. His work began halfway up the side of the NW.44 window, for its shape changes at a level which coincides with his stair corbels on the other side of the stairwell.[17] Here is an unmistakable instance of a change in the shape of a window indicating a break in the construction. The plan for the east side of the window is exactly the same as the one below by Cobalt, but the west side below Red's work is quite unlike him. Its closest relative is the corner window Scarlet built in the SE stair.[18] Marking these three crews on the section it would appear that Scarlet-P began the window on the inside, and that the other jamb was not installed until Cobalt returned four years later, it therefore having taken all that time to install the sculpture and lintels of the N.w door.

When Scarlet's work is extended to the inside it includes the walling alongside the capital under the arcade arch. This makes sense. Scarlet's predecessor had laid out the walls in the triforium in the next bay, while his successor Olive had finished the wall behind the triforium passage over the centre of the second pier, as his masons marks show. The section[19] shows the difference between the triforium and the transept staircase by the end of Olive's campaign - fully eleven meters!

The end of Olive's work is clearer on the east side of the transept, where he finished the triforium wall in four massive blocks with mason's marks, but rather better than his other masonry, in size and finish. They have been carefully cut as they were expected to stand alone for some years until the transept caught up.[20] The scaffolding was left in place to brace the wall against the winds, for the surface of these walls is pock-marked with putlock holes. They are to be found scattered in all parts of the building, but nowhere will you see as many as there are here.[21] There are fourteen in one bay.

Clearly the wall had been heavily braced with timberwork while it was being laid, and it stood there with its scaffolding sticking out all round it for the next eleven years. The bracing would have been connected to the even heavier centering around and underneath the arcade arch to give it full stability, but its purpose would have been only to help the wall withstand the force of the winds, for in time timber exposed to the weather warps and shrinks. Even a single arch of stone would have been better than timber, and this is why the end arch had to be built, and why the inner leaf of the transept wall had to be brought up, no matter what the inconvenience, to carry the arch against the thrusts from the triforium.[22]

I cannot see any builder of experience working in this difficult way unless he was compelled to. No-one voluntarily leaves work undone so they can have the pleasure of solving a harder problem further up. So I had to conclude that the work had been deliberately held back as something was waiting to be done, and what could that be but the sculpture? If the sculpture had kept pace with the rest of the carving, why would they have held up the lintels? And if the lintels and archivaults had been placed why did they take so long to finish the window between them, with its embarassing effect on the rest of the building? I could only conclude that the ultimate cause of the delay was the uncarved tympanum and its surrounding archivaults.

Perhaps there were no sculptors in these six crews? You will read more of this in the next chapter, but in every crew there were at least a few masters who could turn their hand to carving. It may be that the crews working during the pause did not have men of sufficient stature and that the Chapter would not allow them to work on the portals? This does not make sense either as they had allowed much poorer work to be put up elsewhere.[23] And if they had been waiting for better men they could have hired them rather than leave the problem and endanger the building.

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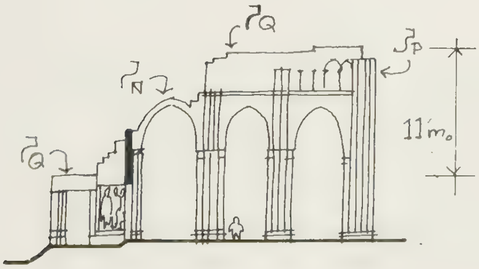
started by Scarlet-P. Cobalt's outline on the other side is from campaign 'S' just before Red, and can be seen in elevation in n.15. Red's altered outline is shown dotted.

18. SW.64 - GEOM:IV-F.

19.



20. There are other stones by Olive in the triforium which are equally well cut. Because I described his sloppy work in the rooms under the roof in ch.II does not mean that all his work is poor. It just shows that he worked to two standards. The crew may have worked piece rates to some, day rates to others. His roughest work is always where it will not be seen by the public.

21. Putlock holes are left in walling by the masons to support the ends of the scaffolding poles supporting the platforms on which they stand to lay the next course. All masters were faced with the problems involved in supporting the ends of their scaffolding poles as the work rose. Some do this by leaving holes in the walls through which the poles can be pushed; or they are laid on top of the last course and the next stone is cut so it will fit over the pole. When the poles are removed the holes are sometimes filled with stone and mortar, though usually they are left for the pigeons. Some masters seem to have less putlock holes than others: are they supporting their scaffolding in a different way? Joints between masters often occur at the level of the holes, for there the work had paused.

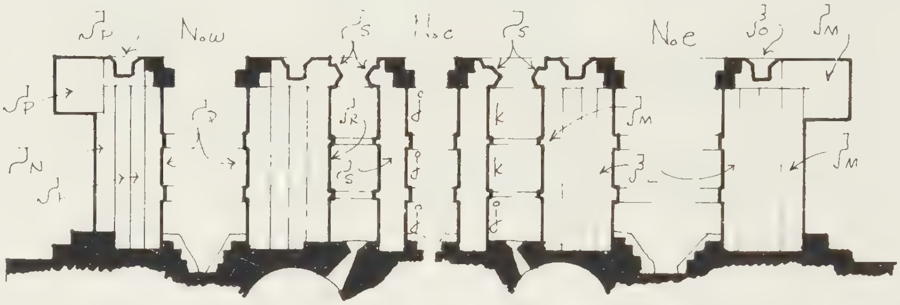
22. Both of the N.III arcade capitals are by Cobalt-*Stitch* - XI:19. Within the NE staircase the problems were not as acute for reasons discussed later. The joints across the inside face of the transept wall are shown on the stair section n.40.

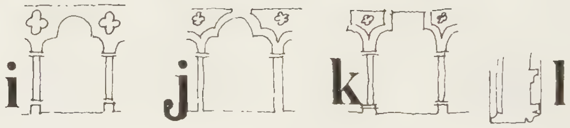
23. Couldn't we say that the S.e tympanum is one of the dullest in the building? And that the quality of many of the archivault figures in the south and around the N.e door are far inferior to those around Job?

Which sculpture had been held up? The answer will come in part from the delays in laying the lintels which encase it. These lintels are not a bit like those in the south whose only decoration is a delicate horizontal moulding along the bottom edge. The northern lintels are decorated with an arcade cut in sharp relief. A trefoil arch is supported on shafts capped with sharp-edged unadorned imposts. Between the trefoils are clover-leaf recesses not unlike those Bronze used over the colonnettes of the south transept and in the arches over the statues above the south porch. The general shape and the outline of the moulding is very similar to the panels carved under the lowest windows in the porches. Though the lower one is simpler, with only a circle cut between the arches, the same moulding has been used with the same crisp edges.

A repetitive horizontal frieze has been carried over each. The two friezes are not the same, but the form of the whole assembly - a geometric pattern over a trefoil arcade - shows the same design approach and the same rhythmic approach to decoration. There are no leaves or natural elements as we see elsewhere in the porch. The forms are crystaline and architectural. They both show a similar decorative method not found elsewhere in the cathedral. The lower work was carved by Bronze in 1198, and the upper would therefore also be his in 1205. He placed the two on either side of the N.e door, and from small changes to the details you can see which ones were carved by later masters.[24] Bronze's motifs were continued, but with variations. This is how ideas were diffused in the middle ages - not by glossy magazines and films, but by direct contact. Bronze began the arcade-like patterns on the lintels; Ruby, Scarlet and others had to follow them, though with modifications. Sometimes a found motif will be so attractive to the newcomer that it will join his stock-in-trade. Perhaps it only appealed to the gang foreman, but then in time it may have come to influence the other gangs until the whole crew came to use it.

As the century passed architecture became increasingly decorative, and the dissemination of motifs could have deeply influenced the development of each master's patterns. For example Cobalt liked to run a fan of fine lines on the underside of the canopies over the wall figures, and over the outermost southern figures Rose copies the idea. Did they both get this from a common source, or was the major user also the originator?[25] One of Cobalt's canopies has lines arranged just like an





24. *I. The north lintels*
Nearly every one of these lintels was replaced in the 1900's. The work was carried out with great care, and as far as I can ascertain from old photographs and documents, the present work is a most careful copy of the old. The small figures carved into the lintels were cut out, and reset into the new stone with joints so fine they can only be seen with good light. A good example of a joint dating from these repairs is the new griffes on the torus under the N.eR2 statue. It can be examined by anyone. And even at eye level, you will deserve a coffee when you have identified the joints round this one.

The first arches put up have a blind arcade decorated with 4-foils **i**. In some of the later lintels the 4-foil recess was enlarged, altering the entire concept from that of an arcade recessed into the mass of the stone, to tracery applied to its surface - see n.25. These ones are marked **j** and **k** on the drawing. The small section with square arches is marked **k**.

Bronze-L
Began the lintels because of the pattern used as discussed in the text. *Brancher* leaves under the statues on his lintel are like his in the S.c trumeau canopy - XVI:**H**8. Notice his 4-foil infil, as used many times elsewhere - XIII:62.

Ruby-M
Continued the N.e-e lintel, and the leaves under the statue on the west side could be Ruby-*Locks*. As this doorway had been opened to the public some years earlier, n.33, and as all the sculpture around it was in place, it was natural to begin here.

Cobalt-N
Built a similar one N.w-wW. Note the way he finished his pattern in the north corner: a splendid allision only he could have thought up - see his work in the next course.

Scarlet-P
Carved the north stone of N.w-w with the smaller 4-foils.

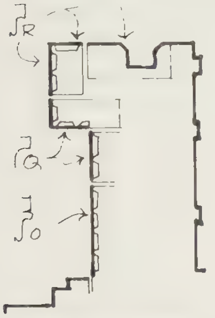
Olive-Q
Altered the pattern for N.w-wE with sharper details. One figure sits underneath a gable with fire-like leaves running up the sides, reminding me of ideas due in the next generation, discussed on the next page - see XXI:5. This lintel sits on an impost which is not carried over the adjoining canopies, and the outline of the impost changes. So this lintel was laid to allow the corner buttress to be continued, and as Scarlet was in the previous campaign, to allow the last of the archivaults to be placed, XVI:**P**, I gave it to Olive. The leaves under the lintel's statues may be *Squelch*.

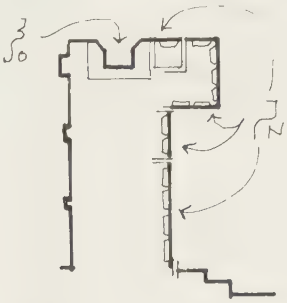
Ruby-R
The N.w-eE could have been put in here. It follows the same pattern as in his previous lintels. It is butted into the stones of the window showing it was placed after Scarlet's jamb - n.15/s.

Cobalt-S
Rest of the lintels, while he was erecting the statues in the N.w doorway. As both lintels are set deeply into the wall of the adjoining windows, the flanking outer row of archivaults had to be laid afterwards - XVI. The figures set into the two central lintels have Cobalt' strong faces, simple folds and his leaves.

This part must be read with the rest of this note and the whole of XVI. It is an interlocking analysis in which the firm attributions fix the points between which we must share out the other variations. In this way we discover the characteristics of the different masters, and as long as we remain consistent it is a valid method.

There is an interesting use of pattern in the placement of the lintels, for in the last ones the masters sometimes found that there were different arcade-forms on either side of the lintel being carved. In Cobalt's around the N.c door he has used Olive's pattern on one face, and Bronze's original one on the other. His reasoning seems to have been to maintain visual consistency as seen by anyone walking through the porch. Thus, moving from east to west all the patterns on the east face would be the same, and similarly in walking the other way. Why did he then change the arcade from round arches to square on the stone marked **k**? The fact that these patterns were recognised suggests that the earlier lintels had not only been carved, but had been erected. I doubt whether these vagaries would have been noticed on a pile of stones lying in the yard.





II. External decorative course over lintels.

There is a charming variety of patterns in this course. The complex and varied imagination of the ones on the east I ascribe to Cobalt, for they follow all the patterns he used in the bases of the north piers - III:39. The ones on the west I gave to Bronze-O as their 4-foil, lobed and rosetted spaces remind me of his other patterns. The next two stones I gave to Olive only because I gave the corner stone in the lintel course to him. The outer ones are Ruby's as discussed in XVI:38/P2.

III. The Leaves Above the Lintels.

Pat Keiller and I studied these at great length without doing much more than dividing them into groups. There are only a few leaves in other parts of the building which can be linked to them. The changes in the patterns are marked with asterisks on the drawing. They may mark junctions between teams, or perhaps only between gangs. However, I think we have drawn a few valid conclusions, though some of the attributions may be shakey:

Ruby-M

A 3x3 lobed leaf at 'a' with the upper lobe sticking out, and a slash between them instead of a raised rib. Reminds me somewhat of *Braid* or *Pawn*.

Cobalt-N

3 leaves on 3 branches at 'b', with pointed ends. The berry has its own pair of leaves underneath. Taking into account the hardness of this stone compared to the softer Senlis used in the porch sculpture, they are not unlike XI:14/f. This band is identical to the one over the 'arcades' above the north porch, being 'm' in XVII:5, which I identify with *Clover*. Similar leaves were carved at 'c' in campaign 'S'.

Bronze-O

Leaves like Ruby, but the central lobe is higher, and at 'd' it is drilled with a strongly indented stalk. There is one berry on each side, 3 leaves per space. Very like *Gash,* a Bronze gang. But could it be Cobalt-*Gobble*? I prefer Bronze as it is like others by Bronze-*Swan* on the other side marked 'e'.

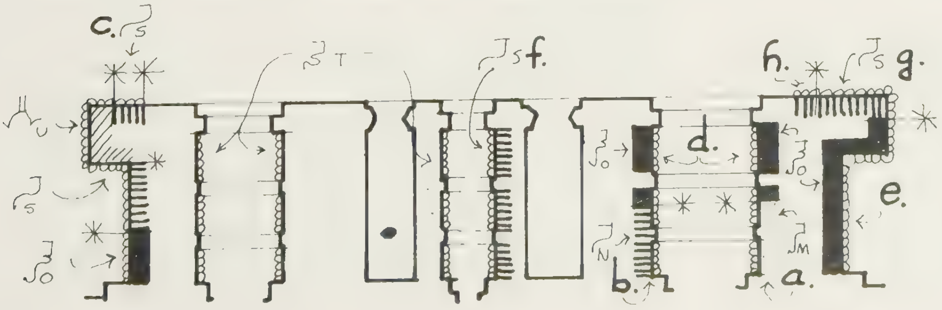
Red-T

3 identical panels. These are the only consistent ones in the porch. While all the other leaves grow from behind the roll underneath the moulding, this group laps over it, disguising it. It has a slightly lipped leaf. For the inadequate reason that it is so unique I gave it to Red. This attribution also fits into his programme of work. From this I would place 'f' with his predecessor Cobalt-S, though they are unlike his others here except for a vague similarity at 'g' and a strong one at 'h' and 'i'.

Rose-U

Lastly, the twisted and drilled leaf on the N.w-wW corner is Rose-*Cup,* as in his work in the south lintels -X:56.

Although I have written many words and spent many hours, with few firm conclusions, the summary of the growth of this porch in XVI:38 seems to confirm these general conclusions. For the ribs and cells of the porch vaults see XVI:38, and for discussion of plate v. bar tracery next note.



25. The easiest place to see these is under the giant canopies over the four added figures in the south - S.eR4,L4 and S.wR4 and L4. All are by Cobalt except S.wR4. See XVI:12. If motifs are diffused in the manner I suggest, then I would postulate that the greater the saturation of the idea in a gang, the longer that gang has used it. Hence I give the idea to Cobalt. It was also used by Bronze, but later, and he placed a rosette in the centre (a boss?).

In the canopy over S.eL4 the hanging arches are definitely treated like bar tracery - that is the mouldings of the members define the limits of the stone, so that all the stone between the members, no matter what its shape, will be removed. In window bar tracery the mullions are built out of long thin stones, curved or straight, like units of railway lines in a toy train set. In decoration the lines of the patterns dominate, rather than the spaces between them, and it appears as if the pattern has been applied to the surface.

In this, bar tracery is in complete contrast to the earlier plate tracery in which patterns are cut into a slab of stone, and the mouldings surround each pattern leaving a sort of no-mans-land between them. In Chartres the western rose of 1215 is an excellent example of plate tracery, and the southern rose of 1227 of bar, though there are still vestiges of plate between its lozenges and rosettes.

Bar tracery is first supposed to have appeared in Reims, and if we assume that it was invented when the mullions were being cut for the aisle windows, 1215 would not be too early. Yet here in Cobalt's canopy of 1203 we have plate tracery. Does this mean that it was a sculpture's idea rather than an architect's? When I argued this with Eric Fernie of East Anglia University in 1978 he maintained that the essence of its importance lay in its structural technique, and that it must therefore have been an architectural invention. To my surprise I found myself taking the opposite position, that the canopy showed that it was originally a sculptor's motif only later taken over and applied by the architect.

There was confirmation of this in the bar-patterns in some of the north porch lintels, and the vault panels in the N.e bay also by Cobalt, dating from 1212. His bases under the shafts of the north porch piers in III:39 are also approaching bar in the methods, and they must be dated 1203, like the canopy. Also, if you examine the decoration under the lowest windows to the porch stairs, in the order in which they were carved - GEOM:IV-G - you will see that earliest of the lower stones in the SE are pure plate, but that they progressively develop into bar-like designs in the NE. Also all four designs in the next course are bar-ish. They are all the work of Bronze-E in 1198. So this idea must have been around for some time before the architects took it to use in the Reims aisle mullions. Was this, like the ribs under the canopies, another Cobalt idea that spread around 1200 to other crews, gained ground among the team's sculptors, but did not surface into larger construction until a generation after its first use? See also X:39 and 50/f, and XVI:12.

English vault with liernes - those short purely decorative ribs which seem to form random connections between the 'functional' ones. The canopy dates from 1203, only a few years after Richard the Mason had used them for the first time in the high vaults of Lincoln.[26] Had one of Cobalt's carvers been working there?

There are little figures carved into the lintels of the north porch, and the canopy over one of them has a steeply sloping gable with darting tongues of fire running up the sides. It is a prototype of the choir arcade at Seez and for the transept arcades in Notre Dame, Paris both of which date from the middle of the century. Yet the lintel is 1210.[27] What have we here? A young man sculpting one of his first independent works and adorning it with the motifs he was to use all his life? Being young he would not be able to indulge these ideas in a major building until he became a full master, but the ideas were already there. As he rose in the hierarchy of his crew he would have carried his dominant ideas with him until many years later, leading his own team, he could apply on a proper scale all the favourite ideas of his youth. We can see in many of the older architects of today the motifs of their youth, refined and matured perhaps, but indubidably stemming from the first flush of their creative experience. So why not in 1200 too?

Olive's lintels, placed five years after Bronze's on the opposite side, illustrate the backwardness of the N.w door.[28] Though the porch pier was here a little behind the others, the real source of the delay must lie on the inside, where the impost on which the lintels were to sit was not yet in place. The impost rests on the large canopies over the statues. As these are set deeply into the wall, any delay there would affect the rest of the transept. The initial cause of the delay around the N.w door must therefore stem from these capitals and hence from the figures they were to support, the figures of Solomon, the Queen of Sheba, and so on. Neither the canopies, the impost nor the lintels could be put down until these big figures were in place. The last lintels therefore date these statues.

The only reason for not carving these statues would be iconographic, the responsibility for which rested with the Chapter itself. I have the impression that they were unable to make up their minds about the subject for the doorway. Can we see them fiddling away their precious time in argument while the work froze? The building's delays began during the time of Ruby-I in 1202, though the Chapter's indecision would have been apparent long before this, and may have lasted until the final stones of the archivault were placed in 1210.

After the first architect presented the plan and model of the cathedral, and the Chapter had considered it, the only real participation the clergy continued to have in the project was to agree on the iconography for the porches. Naturally they would have argued and discussed the matter. Probably, it would not have been the decision of one man, nor even of a small committee: the many levels of meaning and thought which lie behind it show us that. I would not be surprised if the whole Chapter did not become involved in producing ideas and in participating in the general discussion.

But it could have gone further. Being the only major part of the building they could involve themselves in, it may have come to take up a greater and greater part of their time. Their reputation as one of the foremost intellectual schools in France would have encouraged them to go much deeper into it. Not just deeper in the sense that many erudite minds applied themselves to working out a program, but also in the sense that it may have become a political issue with different groups within the Chapter taking sides for one argument or another.

As their reputation as a great teaching centre was at this time declining, they could have followed the historically not unexpected pattern of dissipating their unusued vigour on politics and argument.[29] Any issue can become fuel for such a conflict. As it grows men adhere to one side or another, not primarily because they believe in it, but for personal, political or other status-based reasons. Anyone who has read Snow's 'The Masters', or been close to University life, can easily visualise the scene.

The program in the south may not have been too difficult to work out for it came almost ready-made from church traditions, and its iconography is devoted to the path of Salvation. But it would have been harder to work out a good program for the north. Its arrangement centres on Mary, and the subject for the N.e door was as straightforward as any in the south. The N.c needed more thought, for Christ, Mary and the Old Testament had to be bonded to one another and to the Church itself as the Bride of Christ. The result is one of the most splendid iconographic schemes anywhere in Christendom, and the time it took to evolve is reflected in the later start to some of its sculpture.

But these problems were nothing compared to those posed by the N.w doorway. It was to concentrate on the church, to balance her position against Mary's in the N.e door, and as the authority of God on earth, for only in that way could the deeper significance of the doors be reconciled. The solution is unique in church architecture, and surely reflects the problems the clergy had in finding a solution. It was not just that they did not have acceptable precedents to go on, for the evolution of a new arrangement might have taken months, but not seven or more years. The time it took in spite of pressure from the builders suggests that this door suffered from being the butt of a power group within the Chapter, using the difficulties of the door's iconography for its own purposes.

Katzenellenbogen has suggested that Peter de Roissy may have had something to do with determining the final form of this doorway, for Peter "wrote a commentary on the Book of Job, in which he interpreted Job, as St. Gregory had done before, as both Christ and the Church. He could well have been the author of the iconographic program in its enlarged form at Chartres. It certainly seems possible that he suggested the representation of Job's suffering - which, as far as I know, had never before been represented in a tympanum - as a suitable reminder of the dangers to which the church was exposed in his own times.''[30]

In 1210 Renaud de Mouçon, bishop of Chartres, led an army into the south of France to help Simon de Montfort in his lengthy seige of Termes held by the heretical Cathars. Both the door and the army show the concern of Chartres in the problems of heresy, and not only are these consistent with my date for the carving of the Job tympanum in 1208, but this is also the year in which Peter was appointed Chancellor.[31] We also know that Peter had worked amongst the Cathars, and wrote a book in which Job is shown as the Church, who has to suffer heresies and other abominations on earth to temper its faith. The book is an allegorical summary of the doorway, and with Peter's arrival in Chartres work on it was resumed. The more complex parts of the program date from then, and it may be that the other stories of Tobias and Gideon represent in the archivault what other groups within the Chapter may have wanted to place on the tympanum.

Once the builder was allowed to get ahead he worked with such enthusiasm that the west door soon caught up with the earlier one in the east. Because its sculpture had been set up much earlier, the NE stairs do not show the same confusion as in the west, but how was it protected during this time? The puzzle may not be too hard, for there is a clue within the stairs. The quite regular coursing of the stairs butts into each side of what appears to have been a wall, without bonding into it. The rough face of its

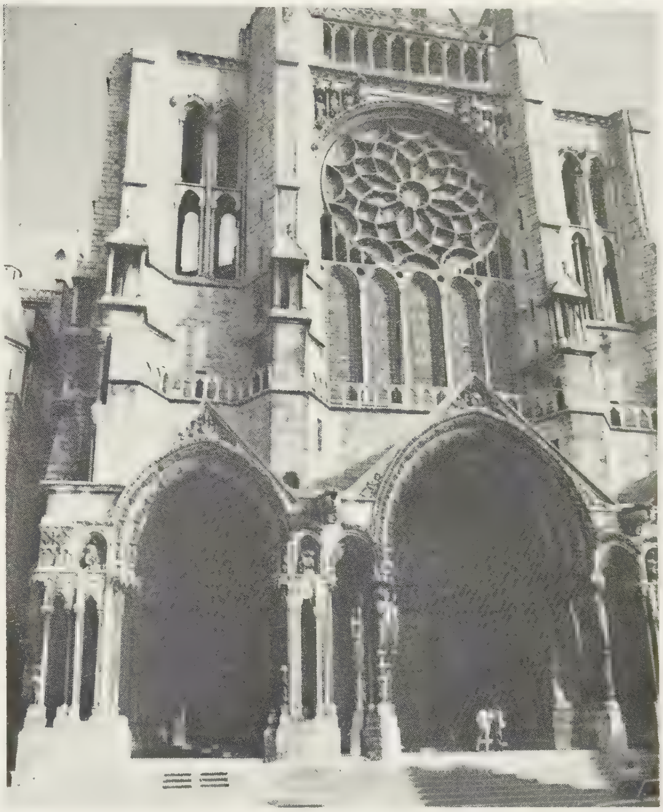


PHOTO 355: The eastern and central bays of the north porch. The stair with the wall shown in n.32 lies between them.

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26. Located in XI:10/y. The 'crazy' vaults at Lincoln date from 1192. Lierne ribs had been occasionally used in France and England for half a century.

27. Seez and Paris both date from the '60's, but the same flame-like patterns are found in the screen of the roof gallery at Chartres north transept dating from 1240, XXI:5.

28. The lintels are not, as I explained in n.24, a primary source, for their attributions are derived from other firmer data. To study the delays to the N.w-e pier start with the carved capitals - XI:14 - the blocks in the course below which I will describe in a minute, and the other supplementary data collected in XVI:38.

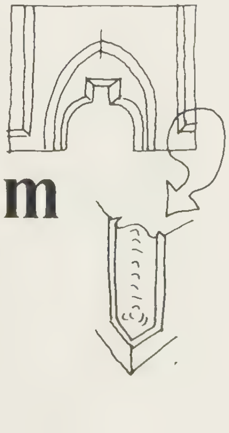
The many shafts which make up each of the piers of the north porch (see plan in GEOM:III-E) are tied together and resolved in a large block placed over their capitals. They were begun by Rose-K because:

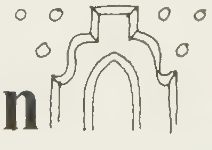
Over the capitals of the small shafts the block finishes with one of the more curious devices in the cathedral. I have seen the same thing over the porches at Laon and Mont Notre Dame, but it is far from common. The little moulding which surrounds the shaft underneath the cap is continued up into the block, except that where it meets the capital it is kicked out like a foot **m**. Anywhere else this foot would have been carved as a continuation of the frame around the column, as it is lower down. But here it frames nothing: it is a sort of anti-frame. It just kicks out, leaving an uneasy emptiness above it.

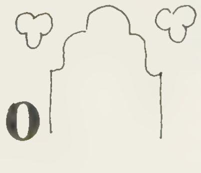
The same moulding is to be found in the gables in front of the two rooms over the north sanctuary - XII:38/IV - where they are carved with Rose's corbel.

The concept of these blocks, where an unstructural 3-foil arch is placed within another arch which itself lies within a huge block of stone, is pure play. It is decoration for its own sake. The forms are not unlike some he used in the cities his men carved over the canopies of the south porch. The canopies over S.wE4 and W4 have small windows enclosed within arches formed rather like these blocks **n**. And on either side of these windows there are openings with Rose corbels **o**, even though they are little more than 40mm high! - XVI:12.

The changes to the blocks in the flanking piers of the north porch are best followed in XVI:38.







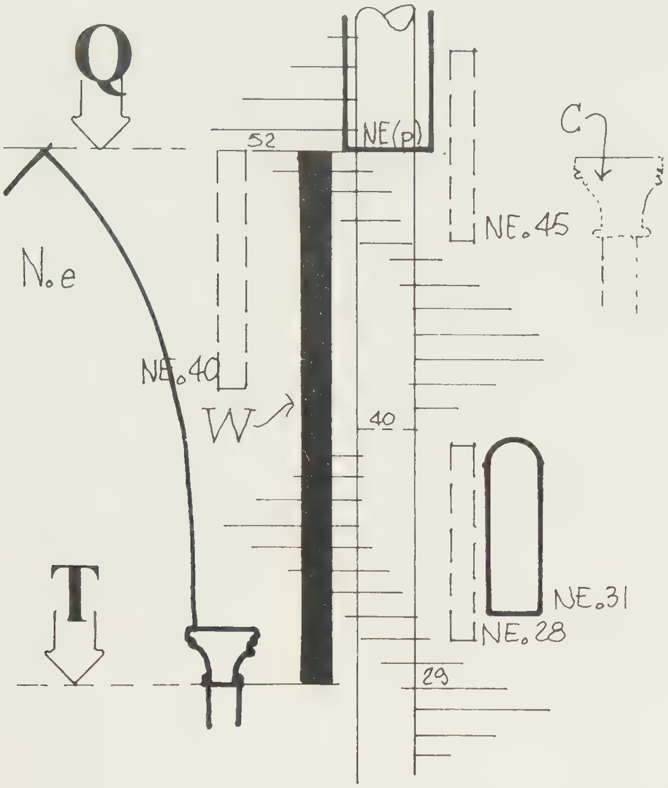
29. "The speculative impulse that characterised the Cathedral School two generations earlier had abandoned it before the turn of the century. The mood was now retrospective, if not timid. Peter de Roissy, though neither the least learned nor the least literate of the Chancellors of Chartres, was as an author the most derivative of them all." Simson, 1964, p.219. The School had passed its heyday by the time the WS tower had been completed, for the high point in its reputation is considered to have been the decade following Thierry of Chartres' return to the town in 1141 when he "took over the direction of the Cathedral sculptural program as Chancellor, and made a vigorous attempt to revive the prestige of both the *artes* and Chartres," Ward, p.243.

30. Katzenellenbogen, 1959, p.78. See n.1.

31. See n.1 - I have used the date of the tympanum, 1208, as it coincides with Peter's appointment. However by my dating, which could be out by a year or so at this stage - I:7 - the Solomon, Sheba and Balaam figures on the left of the door had been begun by Cobalt in the year before. Is my dating retarded here? or was the Solomon decision unrelated to that of Job? or was Peter's appointment a result of the political factions which chose the iconography and appointed the Chancellor in the same act? or are they really unconnected?

stones suggest it was hacked back after the stairs had been finished. But the fact that it is still there means that the 'wall' could not be disturbed while the staircase was being built as it was supporting or protecting something.

32.



The 'wall' W appears between treads 29 and 52 which is from two steps above the last one laid by Ruby in 1202 to five treads above the threshold of the door onto the roof of the porch.[32] The lowest stone is at the same level as the underside of the capitals which support the lintel at T. The topmost stone is level with the topmost voussoire over the N.e doorway. Its position and height fits it for the side wall of a temporary roof over the doorway, protecting the whole assembly from the weather. Presumably there was a similar wall on the east side, now buried within the buttress and the porch roof. I think that this shows that the whole of this doorway, not just the lintels and window 31, had been erected early in the work, and that it could have been commissioned with all of its sculpture before any of the others had been finished. The evidence points to the roof being the work of Ruby in 1202.[33] It meant that one door could be opened into the building through which the clergy would have entered the choir.[34]

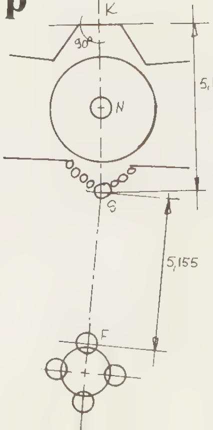
The roofs over the porches could not have been completed one at a time. As long as the western one was held back, the others could not be started. The designer of the north porch recognised that the three vaults supported one another, and that their side thrusts would have to be taken onto projections at each end.[35] Once the end doors had reached the same height all three porch vaults could be set up, the delicate sculpture around the gables placed, and the roofing slabs over that. The work on the porch took another eight years after Olive placed his lintels, and this is why it is the most complex one in the building. Nevertheless most of this delay occured in

Geometry XV-A

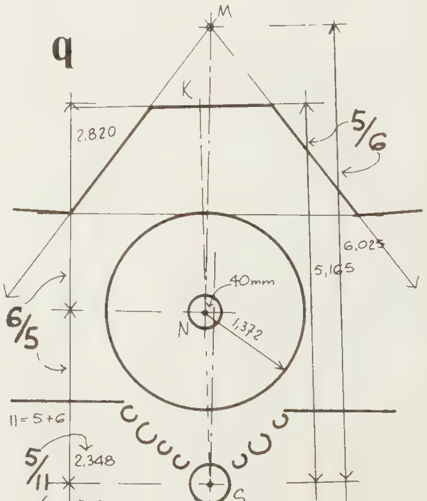
The buttresses over the north porch - Scarlet-V, 1215

The splayed exterior walls of these buttresses are all at different angles to one another, and were not easy to measure. I did it by placing 3 meter rods against each one and triangulating their junctions, and then by relating these back to stringlines tied above the triforium walkway overhead.

p



q



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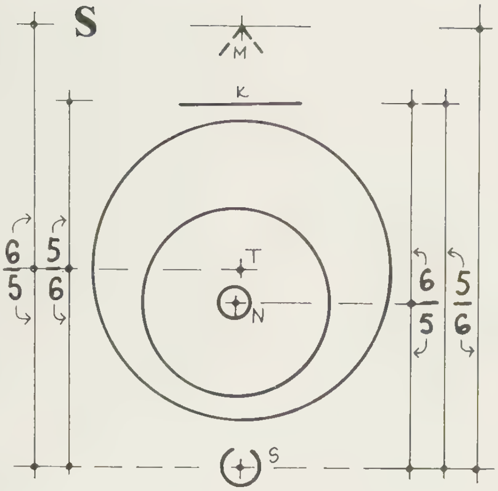
[33] As the wall starts below the capitals and the panels it would have been begun before, or with them. Panel is Rose in 1204 - XI:14/1. As the sculpture for the tympanum and the first archivault row over this door were completed by Bronze-H, the wall would have to be with or after him. I chose Ruby because it suited the position of his work over Bronze in the NE stair, see wall elevation n.40. However the canopies and capitals to the wall figures suggest the 'wall' was built by Cobalt or even Rose - XVI:12. All we can say is that the door had been given a temporary roof by the time Rose put in his panel in 1204.

By 1203 a large part of both the nave and the choir had been opened to the public under a temporary roof - VI:69. The opening of the N.e door would have provided access to the choir. The fact that the first northern door to be opened was the eastern one indicates that more than the nave had been roofed - or was it opened first because it glorified the Virgin to whom the cathedral is dedicated? See Iso-J & K.

[34] Up to 1900 or so the clergy and the public continued to enter the cathedral by the two eastern doors of the transepts, the others being closed except for feast days. The paving became so worn that these bays were closed off for repairs, and the two western doors opened instead. They remain today as the main entrances into the cathedral. VI:63.

[35] The piers in the south have no buttressing at each end, but were designed as if all the loads were vertical, and as if the vaults were homogeneous. It was therefore the south porch which required the most massive repairs in 1899, and only the south porch had to be reinforced with steel beams set into the repaired lintels. The southern layout was the work of Scarlet (though who had built the footings? - X:49), while the north had been begun by Bronze - GEOMS:XVI-A and III-E.



In **p** the distance from the pier shaft F to the wall shaft S was repeated from S to the outside face of the buttress K. The string was bent at K so that it would pass through the centre of the newell N. The wall face K was then placed true to this bent axis, thus reflecting the misalignment of the stairs. The actual dimensions are marked on the plan, rather than the 'ideal', as Scarlet seems to have overmeasured the rod for FS by 10mm.

In the next step the master extended the axis of the arcade, FS, to the north. It misses the centre of the newell by 40mm in **q**. From N he tied another string NM parallel to FS, and outside the wall K he located M the distance of the shaft S from K, plus one fifth. From this point he was to determine the inclined sides of the buttress. The eccentricity of the newell plus the differing axes are both expressed in these sides. By enlarging FS = SK by one fifth Scarlet had repeated the 5/6 ratio between his two foot units, and of his doors in n.36.

Now we come to a most interesting set of moves. Consider first the stairs. At this level the stairwell may have been placed in the wall so that the distance between the pier shafts FS was divided into 11 parts, and five of these were used to locate the newell, shown to the left of **q** (historically the newell had been placed years before in Bronze-E's campaign of 1198. This ratio is Bronze's, and is used elsewhere by him, in GEOM:III-B & D). The average radius of the stairs in the stones laid by Scarlet is 1,372mm, and as we shall see later the wall thickness stems from this stairwell.

The inclined sides of the buttress were located from a large diamond, which was placed tangentially to a circle with radius 2,155mm in **r**. It relates to the stairwell as 11/7 and to half FS as the favourite 5/6. This circle has another centre T, which lies on the true axis of the arcade piers FS. T was located the same distance from S as the newell was from K. A contrapuntal placement. As the newell is 5/11 of the interior pier spacing, the eccentric placement of T must also be related to this space. In fact ST relates to FS as 6/11.

This sequence shows that once Scarlet had made up his rod from the pier spacing downstairs, every other part of the geometry was evolved in place. As all the buttress measurements are a little too large for FS as taken from ground level, I think that his rod was a little oversized. These dimensions are shown as calculated to the right of **r**. Notice that 15 units gives the typical bay, and so relates this buttress to the perch Scarlet had used in first setting out the cathedral.

Examine in **s** how Scarlet constantly uses his one ratio of 5/6, and then in using 11 he was in fact using the sum of 5 + 6. He is splendidly consistent. There are some remarkable plays upon this ratio which cannot be explained in words. Their music-like polyphony can best be seen in the drawing.

Around the large circle in **r** Scarlet drew a diamond locating two of the points at S and M. The two outer walls were thus located, and the inner sides of the diamond passed through the centres of the rib shafts V and R. Alternatively the points A and B of the diamond are each 2,580mm from the FST axis. This is half FS. Thus the diamond would be 5 units wide and 6 long - not unlike his triforium buttress in GEOM:XII-E. It could be encased within a circle with the same radius, and the angle SA makes to AM is almost 90° (by calculation 90.48°, or we could revise this to show that if the angle was exactly 90° then the radius would be 10mm more than half FS. Is this where the accumulated setting out errors, including misplacement of strings, mis-hitting of nails and so on, show up?).

We know from GEOMS:V-A and XII-E that Scarlet 'represented' the direction of the diagonal thrusts along the sides of his diamonds, and by aligning these along the true axis he seems to confirm this. The 5/6 ratio seems to be placed along the direction in which the forces are moving, and by interlacing his centres N and T in the same ratio he seems to have been trying to eliminate the hole made by the stairs. What do you think?

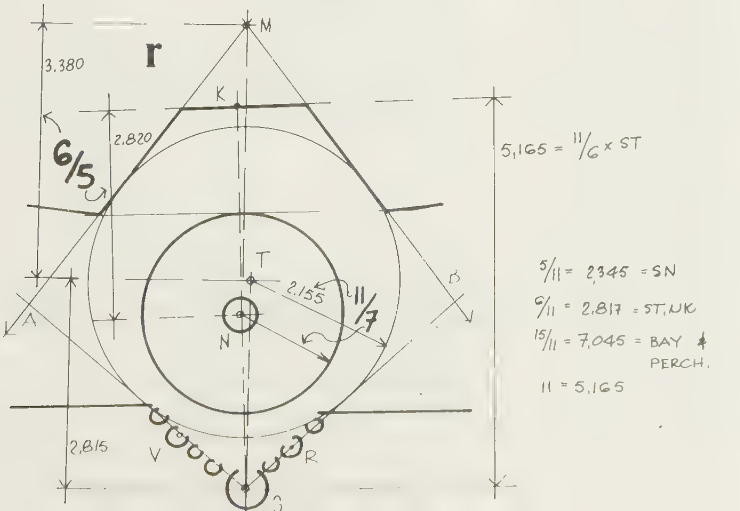
Lastly in **t** join N to the lateral points A and B of the diamond, and then form the north faces of the wall parallel to them, starting from where the sides of the diamond meet the tangent to the stairs L. Notice that this tangent is parallel to the internal wallface, and that the aisle wall W is also tangential to the stairs.

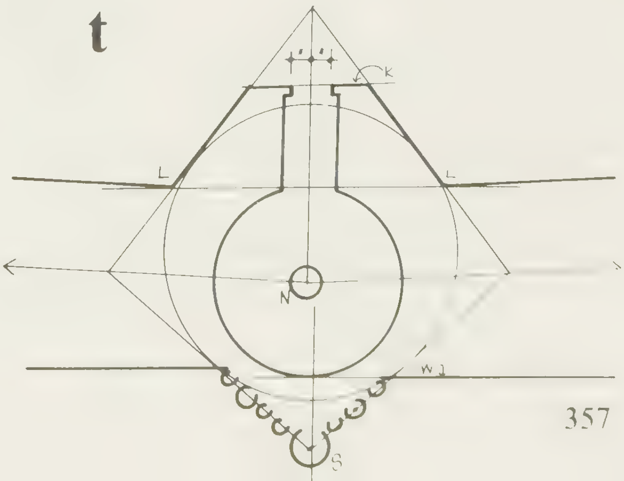
Not only do the points of the prows, being where these lines through the diamonds meet at the centre of each bay, occur exactly at the centre, but, quite amazingly, at these central prows the thickness of the walls has been increased to the same amount. The narrower bays at the aisles do not project as far, but their inner faces were placed more to the south than in the central wall. So in spite of the lesser projection the two flanking walls are the same thickness at their prows as the central wall with its larger projection. Not only that, but this thickness measures 2,820mm, which is NK and ST. Now how did this happen? It may show how pure the original design was that by the time it had reached this level and all the adjustments had been made for axes and stairwells, these elements could still be so neatly correlated.

This may also have been where he established his 'proof', where the steps completed a circle and by returning upon themselves in a sense verified the process he had used.

The opening for the door was not placed in the centre of the wall K, but on the axis of the diamond. If the plane of K was assumed to absorb the thrusts from the misaligned stairwell, then the position of the door would not affect its stability. But if the side thrusts were being taken by the sides of the diamonds then the door location could 'distort' these thrusts if the door was not centrally placed. Does this imply that Scarlet saw the face of the stonework acting as a stressed skin rather than as the edge of a mass, so that the forces were considered to run across its surface? Such an organic approach to structure would not surprise me.

...XII-A/*/XVI-A.





the outer parts, and as the three vaults had been built together, the buttresses and walls over the porch were able to rise in one piece.

The shape of these buttresses is not a bit like the ones over the south porch, and there are two deep door reveals to the stairs set in the face of the buttresses, not alongside them as in the south. These are the ones with Bronze corbels mentioned earlier.[36] GEOM:XV-A shows that the buttress is Scarlet's using the Roman Foot and the Ped Manualis. His geometry uses two squares representing the two forces on the buttress, but the actual stonework only occupies the position where they both coincide, like a polarised image the solid stone materialises where the two forms overlap, which is like the piers he built to support the choir flyers six years earlier.

Between the buttresses the wall bends outwards like the prow of a ship, so that the undulation begun in the buttress extends in a minor key across the whole front. We are facing a major change in Scarlet's techniques, for they are now more dynamic and architecturally agile than in his earlier rectalinear work. It is more plastic in feeling, and may represent the presence of a new master in charge of the team. In the central bay the prow continues to the level of the triforium walkway, but in each side they were capped off, and the wall was straightened at the ridge line. As neither of the side roofs rise as high as the central one there is still a considerable height of walling between their ridges and the walkway. From the ground the change cannot be seen, but from the walkway it is obvious. A new master must have arrived and simplified what he saw as an extravagant idea. When the courses are followed[37] it can be seen that the change was made after

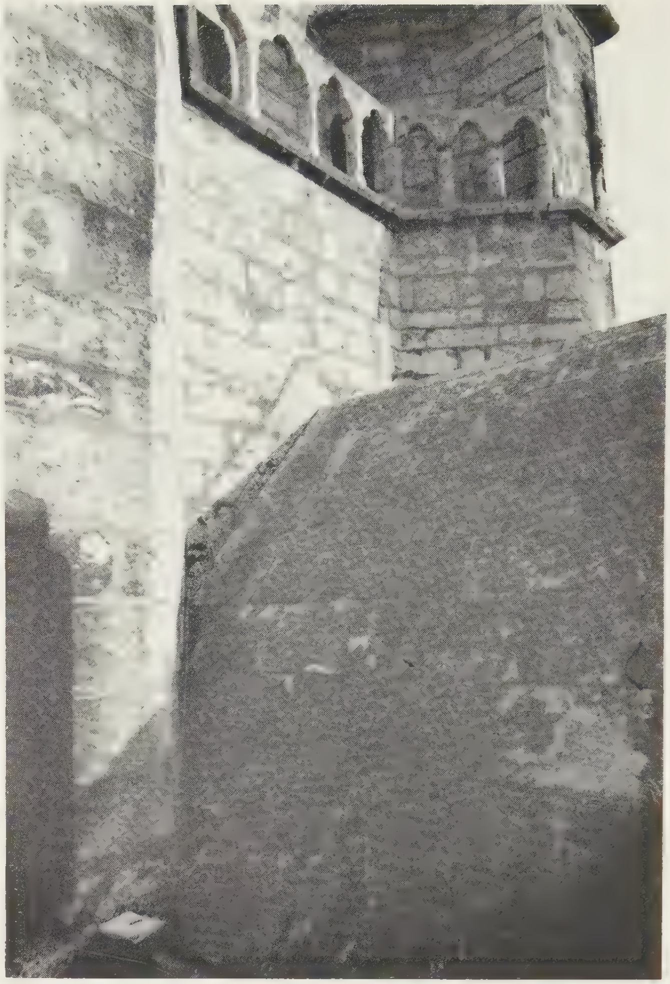


PHOTO 358: The outside of the north terminal wall over the porch roof forms a projecting prow in the centre. The wall was straightened and the prow removed in the course over the ridge. The door into the stairs with its Bronze corbel is on the left.

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[36] See section n.15 and plan GEOM:XV-A. Door passages inside were probably set out by Rose, outer jambs with buttresses by Scarlet, corbel and lintel by Bronze - XIV:9 and 12. Scarlet made the door opening 2/5ths of the buttress width, the jamb 2/6ths of the door, and the lobby 6/5ths of the door - each step is shown in **p**. A complex but typical woven pattern - See GEOM:XV-A.

Though his corbels do not occur anywhere in this campaign, my reasons for adding Scarlet before Cobalt are:

a. To explain the changes in the sill of NW.64 I need a crew between Bronze's corbels and Cobalt's change to the windows. The sill cannot be Bronze - it is not his type. The shape of the window suggested by the sill is not close to Scarlet's others, but it uses the PM, and other things show this master to be changing his methods.

b. I also need another master before Cobalt in the apsidal towers using the PM and harmonic geometry - GEOM:XIV-A.

c. Bronze could have carved the cornice under NE.III - XII:6/i - but those crockets?

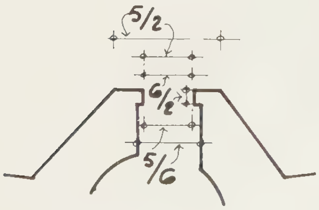
d. The door from the NW room-S is Scarlet's, with the same shape as he had earlier used in the SE-roof(t) door. The set-out of this room has square pilasters, as in SE(t) room - XIII:12.

e. The capitals to the nave flyer spokes are certainly Scarlet's - XVIII:57 - and the bases are his type too.

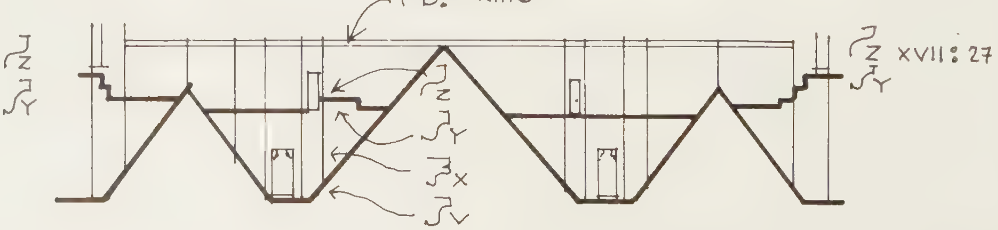
f. N.wOUT upper voussoires may be his, though uncertain - XVI:38/Y2.

g. The crisp cutting to the lower north 'arcades' on the west are like his other detailing. Leaves too? XVII:27.

If later researchers find another master in northern France using the PM, similar windows, harmonic geometry and some of Scarlet's capital carvers we could consider him in this place; but it would raise more difficulties than it would solve. See description of this programme in ISOM-Y.



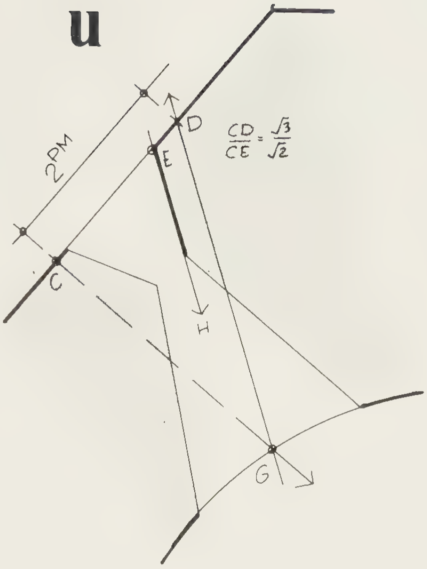
37.



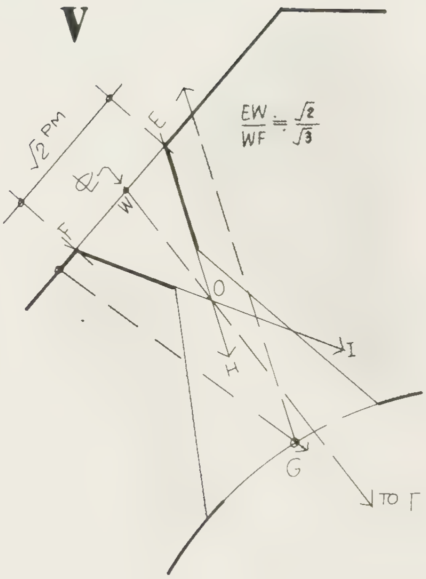
Geometry XV-B

N.64 Window by Scarlet-Y, 1218

u



v



The essential features of Scarlet's style in windows has not changed markedly in twenty years, though some details of his techniques have; compare IV:17 *et seq.* and GEOM:IV-F. In this window Scarlet began with the geometry of the buttress in which it lay, something he had not done before. But remember that he had designed this buttress three years before.

In the previous geometry the angled sides of the buttress were formed from a diamond in **p.** The perpendicular from the middle of the side of the diamond AM, marked C, is shown dotted in **u.** From where it cut the curve of the stairs at G he drew a line to the outside to that CD was 2^{PM}. This was subdivided so that $CD:CE = \sqrt{3}:\sqrt{2}$. Scarlet was still using the same proportional dividers as he had used in 1200. The line EH was drawn back from E parallel to DG. Along this line he formed one of the outer splays of the window.

In **v** W was marked at the centre of the wall face, where C had been the middle of the diamond. The opening EF was then made $\sqrt{2}^{PM}$ wide and the line FI was drawn to meet EH where it intersected the line from W to the centre of the diamond T, at O. The outside of the window had then been formed. W 'just happens' to divide the window opening EF into two parts which relate as $\sqrt{2}:\sqrt{3}$ within two millimeters. His dividers could have confirmed this for him, though it would not have told him that the mathematical ratio was in fact closer to $2:\varphi$, which was not in his repertoire. It is fascinating that here as in the buttress itself Scarlet used both centres, C and W, and evolved the window out of their duality.

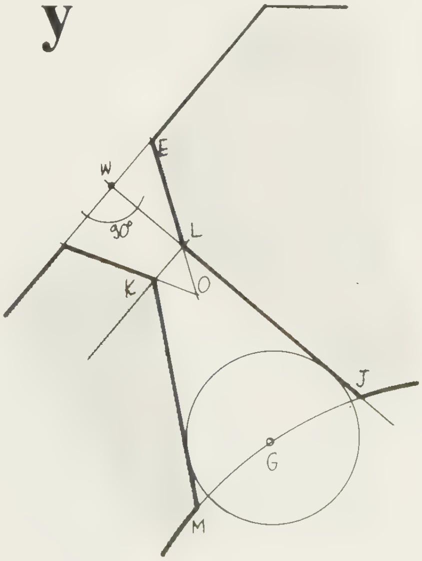
One inside face was formed by drawing the line from W square to the outside wall in **y.** The middle of the window then lay along the line parallel to the outside wall LK, taken from where WJ intersected EO. The last side KM lay tangential to a 1^{PM} circle drawn around G, maybe. These steps follow the same logic he had used in SW.64, except that the first step now came from the buttress diamond rather than from a circle based on his foot, and that the splays were no longer derived from regular angles of 45° or 60°. This may be explained by the fact that in his other windows he had not established the surrounding elements. There is also a change in the second step from an angle to a dimension. These changes may help us date other work by him elsewhere.

There are two generators, CG and GD, which related the side of the diamond to the stairwell, and they have been lost, just as the corners of the diamond within the buttress were lost. The actual sides of the window lie within these generators, and they are placed to relate the wall-face to the stairwell and the newell. The window grew from the differences between these two aspects of the buttress geometry - the diamond and the stairs. In a way the window reconciles their differences. This example shows how important it was in medieval geometry to find two different systems, and then to reconcile them. The problem was posed so that it might be solved.

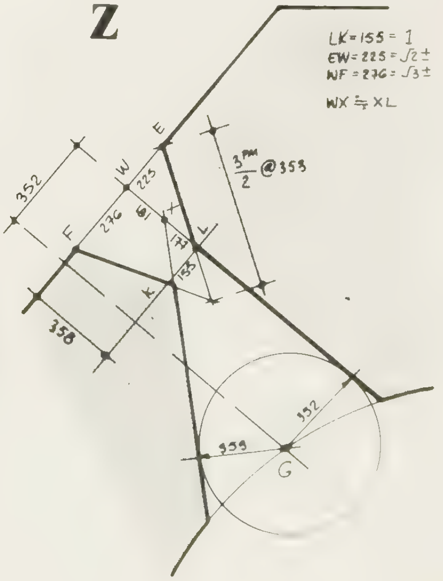
This window also seems to include a number of other items, as may be seen in **z,** so that at times I found it difficult to decide which had formed part of the setting out procedure, and which was accidental. Of all the possibilities the only sequence which produced an orderly set of steps from which I myself could have set out the window on site was the one I have described. There are also three sets of separate relationships: a group of six PMs, a series around the outside splays which relate as $1:\sqrt{2}:\sqrt{3}$, and the 'equal' divisions along the line WO. As these are all approximations the actual dimensions are given so you may assess the 'fit' of each.

...IV-C,F/X:40/*...

y



z



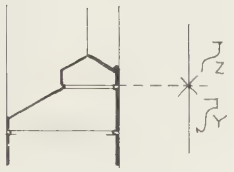
Bronze finished the corbels over the doors, and before the big window was built over the western one.

The section through the sill of the NW window shows it is made of two stones.[38] The lower one lies in the same course as the top of the prow, with a long smooth slope rising from the inside to where it meets the second course. This steps up abruptly to form a new sill higher up. Such an unusual shape suggests we may be looking at another joint: confirmed because on the inside it coincides with a change from single to double treads.

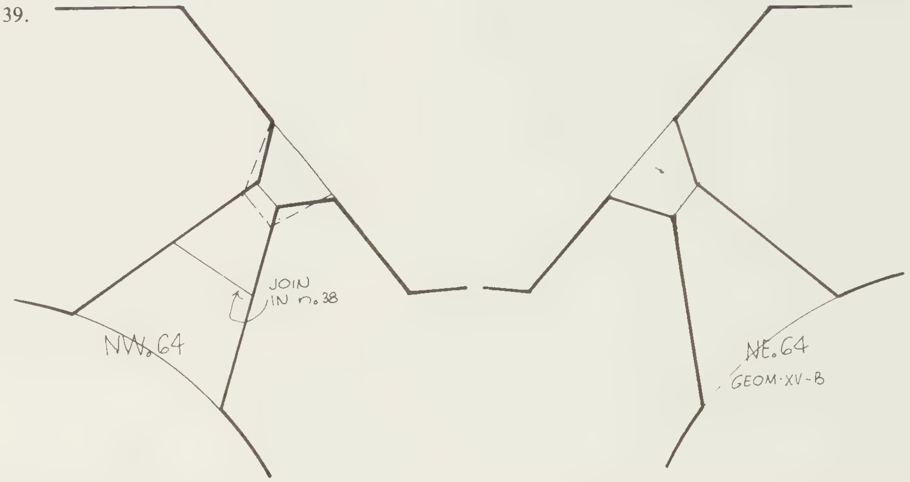
Now compare the sill of this window with its opposite NE.64. Its sill follows the same slope as the bottom stone in the west all the way to the outside, without a step. In plan its inner sides are angled the same way, but above the step in the west the position of the slot and the outer splays have been altered.[39] One master began both windows, but in the west was not able to complete the outside. They were both begun by Scarlet-Y, and the alterations were made by Cobalt. Hence we find Scarlet continuing with the prows he began in 1215, and so it was Cobalt who straightened them out, and built the next three or four courses.

The heads to both windows are flat without splays inside or out. The stair section[40] shows that in the next course the doors begin from the stairs onto the north gallery. They are not like the ones Scarlet built onto the southern gallery, nor are they like anything by Bronze or Cobalt. Their geometry is based on the English foot, so must be Ruby.[41] The heavy ballustrade which caps the solid wall of the transept is also Ruby's idea, not just at

38.



39.



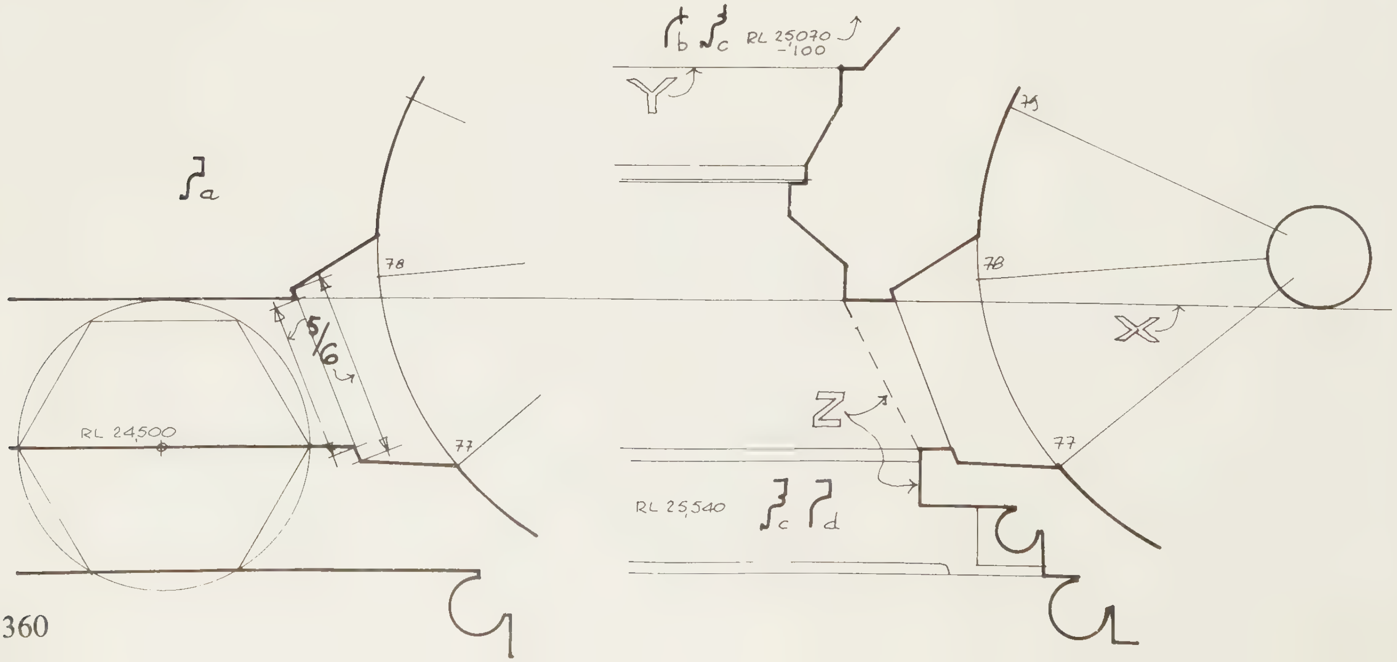
39. The NE window was the first to be laid up. As in all the earlier, and the later work, this side is a little in advance of the west. The join halfway up the sill of the NW window in fact coincided with the change in masters. The shape the latter window would have had if the next course had also been laid by Scarlet is shown dashed.

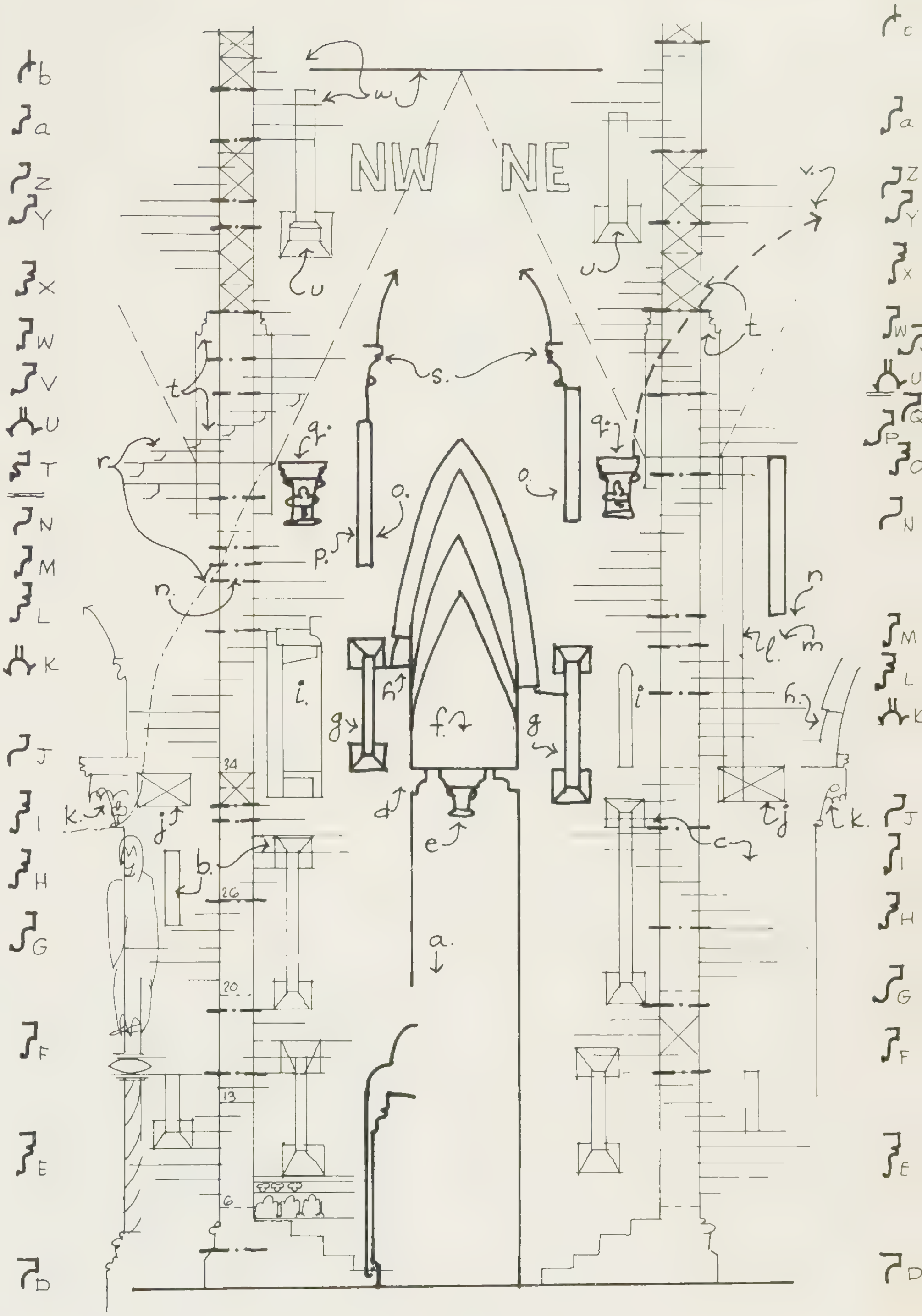
40. See opposite.

41. The proportion between the width of the passage to the depth of the ballustrade is hexagonal: being 2:√3. Though the sides of the two doors are differently aligned to one another, the ratio between the opening and the door reveal is a constant 5:6 using the same dimensions as Ruby employed elsewhere of 635:765mm.

Notice that the inside face of the wall which is to form the lancets and the rose is set out from the stringline X tied to the side of the newell, which is the simplest way to tie a string on site.

It is important in a plan to distinguish which parts were determined by which masters. The walls in the first plan were placed by Ruby, but not the exterior one in the second Y, which came with and after the exterior cornice by Jade and Bronze. Bronze and Olive placed the exterior of the door and the length of the nib Z, and the outline of the lancet window reveal - XVII:15. Ruby may have had quite different plans in mind.





40. *Elevation of the northern transept wall with stairs inside.*

The joints are too complicated in these stairs to indicate with shading. Instead I have marked some of the joints up the newell of the stairs. Many are approximate as they stem from indications in the nearby walls which do not necessarily implicate all the treads that may have been laid in that campaign. After all, part of the stair wall will be built, and then the treads laid on that before the wall over that is laid. But whether the tread was laid with the stones below them, or above would not be clear from the stonework itself. However, this shows that the master laying courses on the outside at one level may be laying treads in the inner spiral of the same stairs at a much higher level. You need to be inside a staircase to visualise this properly, but one example can be seen in n.15, and another would be Bronze's corbel and lintels over the N(p) doors which lie under the bottom of the nearby treads which are all doubles. Also, one master may lay a whole bunch of treads over his predecessors' walling, without laying any walling himself, and *vice versa.* As can be seen in X:21 treads cut in one campaign may be laid in a later one.

a. Lower part of stairs same as in section X:50.
b. Scarlet's NW.21 window - n.5. NW.17 window finished by Bronze - n.15/b.
c. NE.17 finished by Cobalt, capped with a head which curves *downwards.* No window at tread 21, decided by Bronze - n.5.
d. To understand the way the doorways were constructed read XVI.
e. Anne trumeau carved when lintels erected - XVI:1 and **L**14.
f. Lintel and trumeau erected Bronze-K, carved earlier - XVI:**F** to **I**.
g. NW and NE.27 both Cobalt. He completed the head to the NW, but the head differs, and so is by Rose or Bronze - n.9.
h. Cobalt began the upstand for the N.c arch, and on the west side the next course up to but not including the voussoires, for he was waiting for the arch formwork. The thicker arch stones were by Rose - IV:6 and n.15/e. Notice similar changes over the N.e arch.
i. For history of NW.31 see n.13 and 14. For NE.31 see n.12.
j. Capitals and panels on the outside of the wall which support the lintels are Rose - XI:14.
k. Canopies N.e probably erected by Cobalt with 'l' - n.33. For N.w - n.14.
l. Temporary wall within stairs - n.32.
m. Location of the joint between Bronze and Ruby-L can be followed in changes to stone surfaces inside, and in the reduction of the splay under the treads.
n. NE.40 window by Cobalt-M. The flat sill suggests that the joint lies immediately under it. There is no matching window out of the NW stair as he was working too high up on the aisle wall. There are smooth faced stones up to tread of NW.45 may suggest that his joint lies here.
o. NE.44 and part of NW.44 both by Cobalt-S. Flat sills again suggest that the joint lies under the window, and can be easily followed from inside the stairs.
p. West side of NW.44 by Scarlet-P, for he was adding in the stones needed to stabilise the capitals - n.17.
q. Arcade capitals Cobalt-*Stitch* - XI:19.
r. Work in NW stair resumed by Red. He did part of NW.44 and the tread supports - n.7, 8 and 17. The position of the 'hole' is marked.
s. The capitals under the internal arcade are Ruby-*Locks/Hide*. The joint on the east lies under the head of NE.44, for the shape of the window was altered here. This is visible from the floor.
t. The door plan is probably Ruby, with jambs and buttress Scarlet-V - GEOM: XV-A and n.36. Corbels are Bronze-X, as are the double treads.
u. NW and NE.64 windows are begun by Scarlet. Cobalt changed the NW window, and removed the prows from the outside - n.37 and 38.
v. NW.III vault boss Ruby-*Lobby*, NE.III by Bronze-*Dish* in 1217 - XI:34 and n.43.
w. Windows were completed by Ruby-a, along with the gallery doors - n.41. For the work above this level see ch. XVIII.

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this level, but in his earlier campaign five years earlier when he had put caps over the colonnettes on the inside, and began arching them. It has utterly altered the appearance of this wall. In the south where there is only a light railing the wall seems like a flat curtain which acts merely as a foil to the disolving tracery of the rose, and the glare of its translucent glass.

But in the north the projection of the balustrade, and the massive quality it imparts to the lower wall give the whole end a much firmer role. Once again the accidents of design have been fortunate to Chartres. Different masters have provided the richest contrasts without spoiling the effect. The northern rose is more open than the south, as the spaces between it and the lancets have been filled with glass. The weightiness of the wall happily sets off the fragility of the rose, while the relative weightlessness of the southern side does not accentuate the more solid framing around its glass. The master who began the ballustrade in the north could not have forseen the openess of his rose which was to be one of the first High Gothic roses in France, for it was not to be designed for another sixteen years.[42] Through accident rather than good management Chartres is blessed with many felicitous contrasts like this, which quicken its architecture.

The work in the transepts was now sufficiently advanced for them to complete the last of the vaults over the aisles. I think Bronze carved the boss over NE.III with its famous figure of the blessing Christ. He is not unlike some of the figures in the Job tympanum of the opposite doorway: the heavy lower lip, the posture of one arm over the other. He floats on clouds with a layer of material over His left shoulder. Like the angels on either side of Job's God he has a central parting, and his eyes are precisely those of Job's God Himself.[43] With this boss the last of the aisle vaults was completed, and as its cells were being laid the final sculpture in the porch was also completed. The lowest floor of the great cathedral was at last, in 1217, finished. Now that we have brought this analysis of the building to the point where we can show when all the stones of the porches were laid, we can examine the sculpture itself, and begin to relate it to particular teams of men, though not always to the individual carvers themselves.

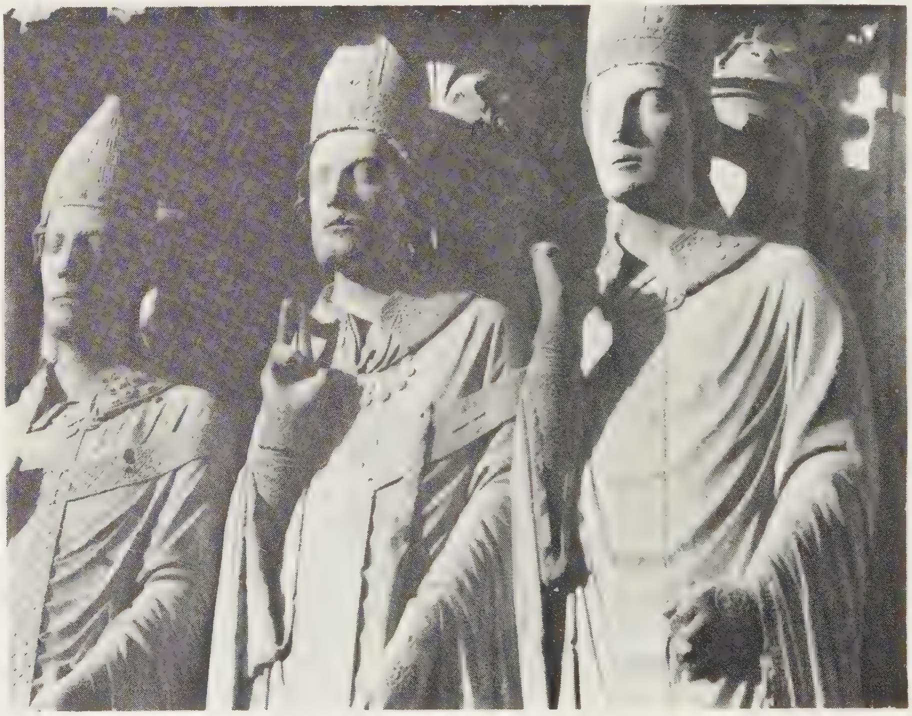

PHOTO 362: The three Confessors on the left embrasure of the S.e doorway.

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[42] Or was he? The north rose is partly his creation - XX:26. Is the date of his arches under the balustrade - 1216 - too early for him to have been considering an open rose sixteen years later? He was at this time helping to erect the solidly encased one at the western end.

[43] I have made this analysis from Houvet's photograph of the boss, and compared it with his of the tympanum - 1930, p.90. I suggest you also examine the almost identical figure with two attendant angels over the rondpont boss in the high vaults, which is also Bronze - XI:34 and XIX:18.

Van der Meulen, 1965 and Delaporte, 1959, pp.312-3 suggest that because there is a Blessing Christ over this door the porch underneath had been built at a particular time. Such theories stem from an un-architectural approach to archeology, for as you can see here the boss was put in 18 years after the first stones to the doorway. Isolated facts from the upper levels cannot be used on their own to interpret the history of the lower parts. Delaporte, *ibid,* suggests it may have been carved over this door because the Bishop entered through it, which makes more sense.

SIXTEEN

Carving the porches

The arrangement belongs to the clergy, the execution to the artist.

Second Council of Nicea

In traditional theory the Gothic monuments were built by a permanently established organisation loosely referred to as the 'workshop'. Though the men employed in these shops are supposed to have moved from place to place seeking employment, many of the leading hands and the master mason/architect who directed them remained on the project for very long periods of time. The overall design and control of the job is supposed to have emanated from this master mason, but the employees were permitted to handle the minor items of detailing and decoration in their own way.

The explanation accounted for the variety of ideas in one building, and the changes we find in the templets.The diffusion of these details over great distances was attributed to the journeys of the men from site to site in search of work. Thus the master and his organisation was permanent, and his men mobile.

The great cathedral workshops - principally Paris, Chartres and Reims, where building operations were in progress for many decades - were thought to have been the source for all the ideas and inventions that brought the Gothic style into being. From them these ideas percolated throughout France, transmitted by the men.

The work I have done on Chartres, and on other monuments - both contemporary ones in the Paris Basin and earlier work in Norman England - shows that this traditional view is not universally accurate.

FIRSTLY the workshop organisation was not permanent, but temporary and peripatetic. The masters who directed the work were more like modern contractors than architects, being principally occupied in building rather than in design or supervision.

SECONDLY these masters resided on each site for short periods before moving on, though they often returned many times.

THIRDLY the design decisions each made were personal enough to indicate the junctions between one master's work and another. The way in which basic concepts for the exterior of the building, like the form of the windows, the use of sills or walkways, the silhouette of the roofs around the triforium and so on, would be changed from campaign to campaign suggests that there was no design authority above each master. However, the effort made towards a common scheme for the interior shows that there was a model or a drawing, probably prepared by the first master and held by the Chapter, which every master was instructed to follow no matter what his own ideas may have been. Though the smaller details were determined individually, the general view of the interior remained the same. For example, the windows of the clerestory were being erected to the same design for some thirty years, even though at the end of that time in the last bays of the north transept the arrangement had gone out of fashion a long time before.

FOURTHLY the way the details can be followed in bands across the building, rather than being scattered randomly, shows that the responsibility for ordering all the templets was not the men's, but the master's, and that he left few decisions to the masons under him. Employees were not responsible for the detailing, but only for the minor carved work in leaves, friezes and so on. Everything else was under the exact guidance of the master.

FIFTHLY each man's own way of carving the decorative elements like bosses and capitals shows how long each man stayed with his employer. The masons who placed their marks on the stonework of the triforium only did so while Olive was in control. The only other time we find them is lower down in Olive's earlier campaign in 1197. The leaf-carving gangs like *Rocky* and *Frills* who carved capitals in the lower apse passage during Ruby's campaign of 1199 are not to be found again on the cathedral until Ruby came back in 1206, and were again absent until he returned to carve the eastern clerestory caps in 1216. The identification of the gangs doing the decorative carving shows in case after case that the men worked continuously under the one master, that they came to the job with him and left when he left. Hence we can say that all the men that can be individually recognised appear to have stayed with their master, permanently under his control, and that they moved with him when he travelled from one job to another.

These masters were like modern builders offering an organisation to their clients, complete with skilled men and equipment, and presumably employing locals for most of the unskilled tasks. Though this was not the universal arrangement, as we know from later account rolls, Gervase's description of Canterbury, James of St. George's work on the Welsh castles and so on, the evidence at Chartres shows that something like this must have been fairly common in northern France around 1200.

Consequently the traditional view must be modified.

The workshops at many of the cathedral sites should no longer be called permanent, nor should we say that the concepts of Gothic were necessarily created in Paris or Reims to be then disseminated outwards to lesser sites. The master contractors should be recognised as the primary, if not the sole source of both the works themselves, and the ideas to be found in them. They were the ones who travelled widely taking their ideas with them, and where possible incorporating them into all the buildings they worked on.

Thus it would have been just as likely for new concepts to have been first tried out in the provinces as in the cities, and for the first example of an idea that would come to inspire thousands to be contained in a small or remote building as a large one. Chartres was as likely to be such a site as metropolitan Paris or provincial Etampes.

Ideas were not therefore disseminated by junior masons who had picked them up while working on one of the great sites, and who were then able to convince less competent or advanced masters elsewhere to use them. This seldom happens in real life. Instead ideas were disseminated because the masters themselves who invented them used them wherever they took charge of a building, and their men did as men have always done, and worked to instruction.

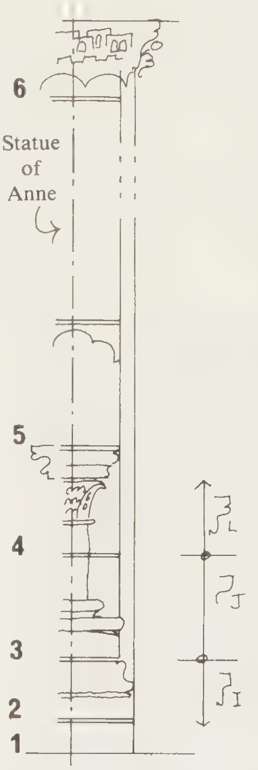
This seems to have applied as much to sculpture as to architecture. The evidence in the sculpture is not as strong as it is in the architecture, but there are many indications that will be discussed in this chapter that most of the sculptural work on the cathedral was carved by the members of the building crews. It has been assumed that the best sculptors would have worked in specialist workshops, doing nothing but sculpture, and though some of the figures at Chartres may have been carved by freelance workers not regularly employed by the contractors, like Avit and John, the great majority seem to have been the work of the building masons. If we consider the enormous variety of sculptural work between Chartres and Reims it is obvious that many many individuals must have been involved, and yet could there have been enough work available for them if sculpture was all that they did? A calculation could be made, I am sure: but in my bones I feel that what remains shows that there would have been far too many people working on far too few pieces to justify these sculptor's lifetime commitment to carving alone.

Also, as we shall see, there are details on some of the pieces of sculpture that will connect them to specific gangs among the crews, and that when we chronologically order the carving work, using evidence from both erectional considerations and gang connections, most of it fits into the same annual banding of campaigns as found in the structure itself.

Like most historians I was brought up on the traditional approach to the sculptors and their workshops. Yet in spite of the great deal that has been written about it, there is little agreement on the dating of either the doors or the porches.

Some architectural historians say that all three southern doors were built around 1210, along with the central door on the north, but that the side northern doors were chopped into the wall almost a generation later - yet there are a number of art historians who link these northern side doors with those in the south believing both to be by the same people. In another example the piers of the north porch have been linked with the doorways in both transepts, yet some believe that the north porch piers were not finished before 1250. Clearly it would be a kindness if we called the situation unclear.

The real problem is that there is almost nothing to go on, except for two small details. Firstly the statue of St. Anne in the north trumeau is generally assumed to have been carved after Louis, Count of Chartres, purchased



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1. Delporte, 1959, p.301 gives the date for the donation as between April 1204 - April 1205. Sources are to be found in Lepinois and Merlet, 1865, iii, p.89. See discussion van der Meulen, 1967, p.154, n.18.

The construction of this trumeau seems to have involved three crews: the two lowest courses I attributed to Ruby-I (1202) because of the shape of the horizontal moulding, the way the corner was splayed, and the leaf in it which is like the one he carved in a similar situation in the upper 'doors'.

The next course overhangs the previous one on the east side, so a new templet was cut. I gave this to Cobalt-J rather than to Bronze-L, as the stone is different to the fourth course.

The fourth course is unique, for it was cut from marble and polished. The capital is a beautiful surface arrangement by *Lobelia*. This is therefore Bronze-L (1205).

The fifth course with the statue of Anne is discussed in **L**5. The bold capital letter refers to the sections discussing the sculpture between page 372 and 393. The canopy with angels on each side and leaves by *Pruner*, **L**13, also has a Bronze corbel on the inside. Therefore also in campaign L in 1205.

Frankly, from the elevation of the north transept wall in XV:40 I would have preferred to have had Anne carved and placed earlier so that the lintels could be built in with the surrounding walls by Cobalt in 1203. If so, then Anne was carved before the donation, suggesting that Louis may have purchased her relics in order to satisfy a recognised liturgic need, of which Anne's statue was another manifestation. However, as the centre of the lintel was supported on the trumeau it was not critical for the builder to put it in with the walls - see later text.

2. Van der Meulen, 1965, p.120-1; also 1967, p.154, n.18.

3. Grodecki, 1951; Medding, p.93-8.

4. Translated in Branner, 1969, p.99. On the actual architectural situation see chapter III. On various datings see Aubert, 1929, and 1949; Grodecki, 1951; Mâle, 1958; Medding; Sauerlander, 1966; Schlag, 1943; van der Meulen, 1965 and 1967; Vitry, 1929; Voge, 1914.

5. Salet, 1967, p.350. See another interpretation of the dating of the Reims labyrinth on pages 543-4. See Branner, 1961 and texts referred to in Salet.

6. I am supported by Harvey, Knoop and Jones, Aubert and Collombier.

the relics of her skull and donated them to the cathedral some time after April 1204.[1] Secondly one of the small figures under the southern trumeau has been identified with the same Louis, and for convincing reasons dated before his death in the Crusade in 1205.[2] Apart from this there is no further documentary evidence to go on.

Consequently dating has been somewhat personal, from Grodecki who believed that none had been carved before 1210, to Medding who wished to see all the doorways complete before the same date.[3] How much more varied could you be? Some have placed the first sculptures in 1200, and have said that while the doors may have been finished in 1215 the porches were not completed for another thirty years. The dating of just one of the doorways, that of the Virgin's on the eastern side of the north, has been set from 1200 to as late as 1235. On the whole, most modern scholars seem to be content to bring the dating closer to 1200, and to reduce the time spent on the sculpture to about 20 years. With this I am in complete agreement, though I would ease it back a little more so that the first piece of sculpture could be carved in 1196, and the last by 1216.

The principal problems in dating stemmed originally from a nineteenth century misinterpretation of the document of 1224 which recorded the decision by the Chapter to move the stalls of the money changers from the south porch "so that all dues ..... might belong to the Chapter, and that whoever should be elected to the deanship might not lay claim to them."[4] This had been interpreted to show that the south porch had not yet been built, and that the money changers had been moved out so that the builders could move in. This was clearly a wrong interpretation, but from it historians wove a fabric of dating which related Chartres to many of the most important monuments in France. For example the only firm reason for dating the western doors at Notre Dame, Paris in 1220 is that the Virtues and Vices there were thought to be related to those at Chartres. Since it was assumed that the Paris workshop was the original centre, it had to be dated before the presumed addition of the Chartres south porch.

Then the third great centre of sculpture, Reims, had to be fitted into this, and into the quixotic interpretation given to the phrase on its labyrinth that Gaucher de Reims "ouvra aux vossures et portaulx."[5] From this the western sculpture was dated around 1245, which tended to pull the dates for many of the Chartres north porch figures into the 1240's rather than in the 1210's. Behind this lay the unproven assumption that Gaucher had carved what he had erected, in spite of the fact that their location marks suggest the opposite.

To these false trails were added a number of preconceptions on how a style should develop. For example in 1929 Emile Mâle suggested that the figures of the Visitation in the N.e doorway must be the last carved because they do not stand alone, but turn and relate to one another. As it was thought that group sculpture was more advanced than the self-contained figures in other doorways it must be later. This is why historians so quickly accepted the Grodecki thesis that the two side doors in the north were installed years after the central door. Yet there are group figures in earlier sculpture, and there is even a Visitation in the Royal Portal where the two women embrace one another in the tenderest fashion. To date the N.e doorway later than the others for this reason is absurd. In fact the building evidence shows that it was the first doorway opened for public use, not the last!

The dating proposed here is entirely based on the architectural evidence, and not on style. The two poems which record the fire of 1194 and the completion of the vaults around 1222 provide the limits within which every campaign may be dated, including those in which the doorways and porches were erected. If this scheme is accepted, the consequence will be to push back the sculpture at Sens, Reims and Paris, and perhaps even Amiens, to a time closer to that of Mantes, Laon and Senlis. Indeed, the more I ponder the problem the stronger is my impression that the Golden Age of French sculpture must be placed in the few decades around 1200, with a peak that coincides with the boom in building construction, and that the Age lasted about two decades, perhaps three at the very most.

I have some trepidation in writing this chapter, for I am not a sculptor, and I am not naturally drawn to the subtle and sensitive arguments used by most art historians. It is a most difficult subject where many minds more skilful than mine have stumbled. As my training inclines me to look on sculpture in an architectural manner, I shall wherever possible use the observations of other men. Yet as Rabindranath Tagore wrote in his *Reminiscences* I feel I may still "see the triumphal pillar of argument, erected upon my nice distinctions, crumbling before my eyes at the merciless assaults of authoritative quotations, and the door effectively barred against my ever showing my face to the reading public again." However, I have comforted myself with the thought that where so many are unsure of the way, it is better to make forward boldly rather than hold back and wait for ever. At the worst I will have ended up in the wrong place and must start again. Yet while there is action there is still the possibility of finding the right path.

I began with the theory that has dominated this entire work: that the members of the crew worked for the same master for many decades, if not all their lives, without changing employers as we do. If this is wrong, and if their employment was as mobile as ours is, then much of my argument crumbles. This theory fits what we know of medieval society, and the necessarily permanent ties engendered by the feudal contract. A few men may have moved from master to master, or been loaned; a few may even have been as free as Hess's Goldmund, but I have assumed that they were the exception rather than the rule.[6] As I wrote earlier, the master was the feudal lord of his men. He held a high position in the medieval hierarchical society. The masters carved their heads alongside the kings and bishops who commissioned the cathedrals, they commemorated their names and work in gigantic labyrinths set into the floor; they mixed with the greatest in the land, and could have expected their men to treat them as villeins treated their lord.

It is in the sculpture that the theory is most likely to be wrong. Here if anywhere we should find freely roving individuals, moving from place to place, and carving the masterpiece or the mundane. Such men could not ever be fitted into any theory of permanence or consistency. Yet among the best pieces of sculpture I have found only three which do not fit into a team pattern: the John in the north, and the two local saints Avit and Laumer in the south. Every other piece of sculpture - and I mean real sculpture which says something individual and deep-reaching - falls into one or other of a few groups. The members of these groups seem to arrive on the site together, work for a while, and are then replaced by another group. The critical points come when they return, even three or four times, and each time repeat the styles and ideas they had used before.

I read all that had been written on the subject, and checked it out at the cathedral. I noted every correspondance that others had found between the statues, and added my own observations and those of other sensitive people, including my father, a professional painter and art critic, who wisely warned me "to beware of wishful thinking. It's awfully easy to hang enormous conclusions on fragmentary or uncertain premises. Everything hanging by a whisker, as the saying goes. Still, intuition does enter into the process, and shaky as it may be, sometimes its the only way to get any insight."

Being orderly I collated every correlation on cards, so that theoretically all I had to do was to 'build' the doors and porches with the cards, laid in the proper order, to find the answers. Naturally there were many snags. Firstly it turned out that much of the sculpture had been prepared long before it was erected. Secondly the design for the doors seems to have been modified a few times so that earlier sculpture had to be recut before being set up. Thirdly some extra figures had been added into the program form time to time.

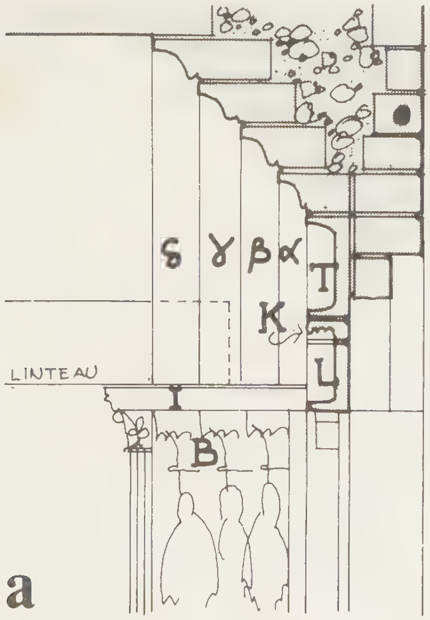
I found that before I could build my house of cards I had to know how they physically built the original. Starting at the top, and working backwards, it was obvious at once that the porch vaults sit on the outermost ring of archivaults, and that its stones could not be placed until the sculpture was complete. Each archivault - and there are often five to a door - consist of separate stones carved with delicate figures cut to suit the form of its arch.[7] The outer stones sit over the one below and inside of it, never the reverse. And this gives the clue to the way it was erected.

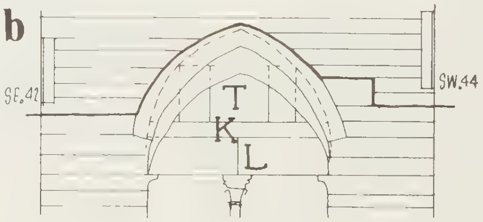
Wooden centering could not have been placed under each arch without endangering the sculpture, for the exposed face is entirely covered with figures, leaving no space for support. But by extending the stone into the

7. In the section **a** the porch lintels L could not be placed until the canopies and baldachini B had been put in, with the continuous impost moulding laid over them I. Conversely the last of the archivaults could not be laid until the lintel was placed as it lies behind them. From within the stairs it is clear that the windows between the lintels were built with or after them - X:48/i. From the coursing on the south it is evident that the SW.44 window could not be started until after the outside window. So you can see in the elevation **b** that if SW.44 was after SW.31, and so after the lintels, then inexorable logic forces us to conclude that the tympanum and the archivaults were in place before any walling above the solid line. See X:48. The continuity of the coursing on the inside, through the stairs to the outside precludes any other interpretation. Hence, no matter which way you examine the problem, there is only one way to build the porches. Re-read ch.IV.

Stephen Murray in his review of the first five chapters of this book, in the Journal of the Society of Architectural Historians, 1979, pp.279-281, notes that "sculptural elements might be *spolia* (pieces saved from an earlier project), or they might be chiselled after the completion of the architectural frame, either *in situ* or as detached column figures that were later fitted into place." The latter would not apply to any of the wall figures, other than S.w4, for the archeological reasons being discussed. It is doubtful if any of the archivault figures could have been inserted later without leaving signs in their joints that are conspicuously lacking.

The possibilities of *spolia* are more important. Avoiding stylistic comments such as 'this figure appears to come from another period', the best I can do is suggest that in the few cases where figures do not readily fit into their setting, this may be so. But the height and width of all the wall figures (except for some of the Confessors, which few would want to date any earlier, and David in the north embrasure) is so uniform, and the diameter of the shafts to which they are attached so equal, that it might be rather surprising to have found in the earlier building just the same dimensions as were required for the new. Neverthless the possibility remains. A summary of misfit or recut stones appears in n.28.





wall it could be supported on the one below like a corbel, one row over the other, without any centering at all. Not only safe, but economic. Notice in the section how the inner archivault rests on the tympanum itself, and that behind and independent of the sculpture lie the arches which support the inner skin of the transept wall.

Have no illusions about the difficulty of erecting this work: some of the archivault stones would have weighed 200 Kg. and would have had to be moved entirely by hand. I assure you it would have been one of the most demanding tasks in the whole cathedral. The stone of the tympanum T rests on the lintel L. But the lintels were usually cut from two separate stones, not one, and were jointed in the middle. The central doors have a post or trumeau to take the load, but in the side doors there is none. The only reason it stays up is that their lower edges are jammed hard up against the walling at either end, and are firmly butted together in the middle. In most cases the lintel extends into the wall behind the adjoining archivaults so it could be held directly against the denser limestone of the walling, rather than the softer Senlis-type used in the archivaults.[8] Their natural tendency to rotate and fall is restrained only by the firmness with which they are packed against the end walls. I would therefore be surprised if the lintels were not erected at the same time as the walls they butt into.

PHOTO 367: Canopies and statues to S.cOUT,L5 by Bronze.

The lintels rest directly on the corbels over the doorway, while the archivaults sit on the canopies over the wall statues. The drawings of the south porch in the Departmental Archives which were made in 1898 by the architect Mouton show that these canopies extend over 600mm into the wall, and that the next course rests directly on top of them. The canopies hold the huge wall figures in place: iron pins extend through them into the top of the figure, and another pin holds the bottom onto the string course.[9] Thus wall figures and canopies must

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[8] In these sections through the edges of the lintel L, the canopy over it K and the tympanum T, the drawings are arranged with the southern doors at the top and the northern at the bottom. The different methods used for handling the edges can be used to apportion them among the different crews as effectively as any other architectural motif. Notice that L and K are usually continued behind the archivault (S.e the only exception, and the only one to have settled!), while T is always contained within the archivaults and directly supports them. T must therefore have a frame around it, and this is often skilfully disguised in clouds. The edge detail may change when matching an earlier stone.

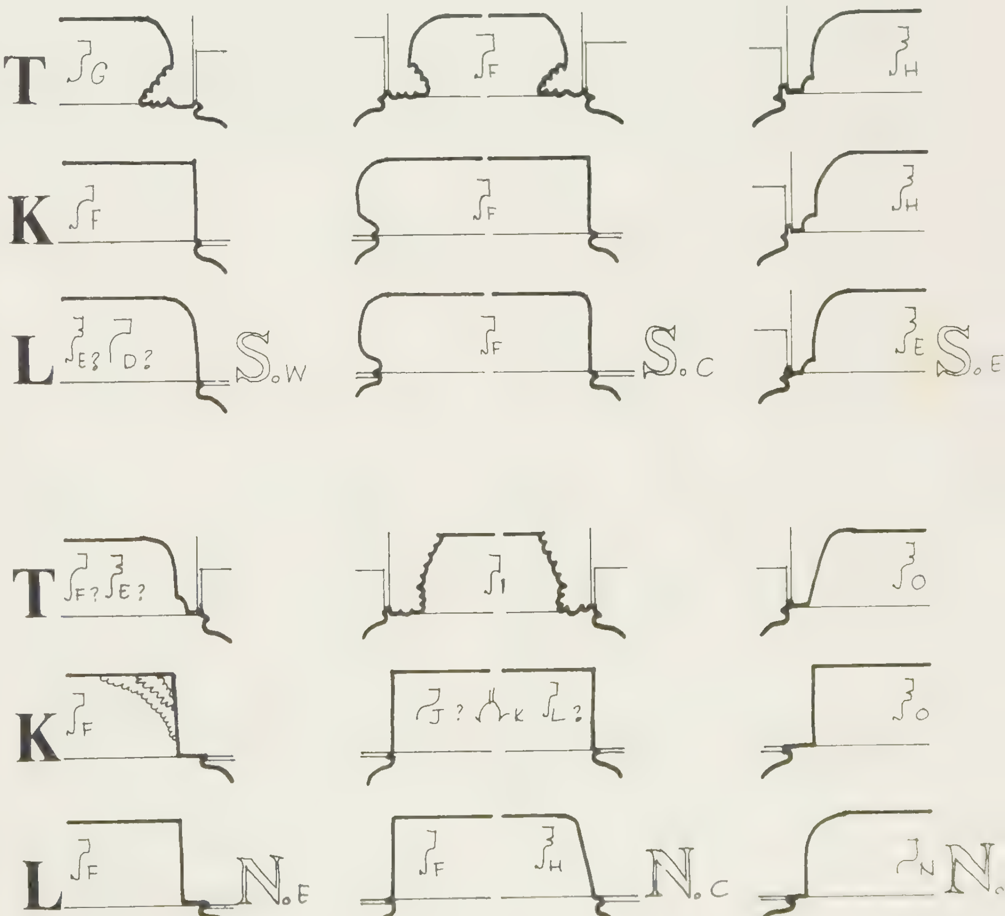
Scarlet -
Begins his clouds within the frame of the tympanum, without disguising it.

Bronze -
Frames all three, curves the inside so the space dissolves, and often uses a half-round scotia at the edge. N.w canopy an exception.

Ruby -
Never frames L or C, and finishes the inside with a sharp corner. The S.w canopy has a square corner sitting over Bronze's round one. The N.c canopy is square, possibly by Ruby; notice the inserted stone.

Cobalt -
Frames his lintel with a roll mould.

[9] The upper pin can still be seen projecting out of the canopy over one of the statues destroyed in the Revolution - N.e-e pier.



have been set up together, and would have had to be carved by the time the architectural program had reached that level. This includes the enormous canopies, twice the size of any others, which support the four outer saints in the side doors of the south.

The lower pin continues through the string mould to support the twisted Solomonic columns which sit on the tori. Stringmoulds and tori are carved from large stones extending from one end of the embrasure to the other, and they continue right through the wall to appear on the inside of the stairs. Every part of the doorway tells the same story: the work was constructed with one stone resting on another, and it was all bound together in the most secure manner they could devise. No matter which way you examine the stones, there is in the end only one way in which the porches could have been built. The confusion inside the NW stair is ample demonstration of what happens when this natural sequence is disrupted.

Having understood how it was all built, I could now return to the pack of cards. Naturally the carving of the statues is linked to the extent that they were all erected together, but there is nothing in the wall figures to show the order in which they were carved. It is only above this in the tympanum and archivaults that the order stands out: on the not unreasonable assumption that the lintel would have been cut first, then the tympanum itself and lastly the arches in concentric order working outwards. This is the way they would have been erected, and would be the natural way to cut the templets.

I arranged the cards for each doorway in this natural order, and then began aligning the work of each gang across all six doorways. An order began to appear. For example, one recognisable gang carved the soft willowy figures clothed in supple delicate fabrics in the S.e tympanum and the N.e archivaults.[10] They returned a little later to finish the outermost arches round the vaults of the south porch and the tabernacles on the piers of the north. They returned a third time and carved some fey and dainty females outside the northern vaults. Working around similar ideas, this gang carved one major figure, the sensitive dreamy Modeste, with fabric of the lightest muslin, crisp edged and flutter-seamed like putty. My nomenclature for its location is N.w-w,W1.[11]

In an other example the work of one gang included the Solomon lintel in the N.w, many archivaults and some of the High Priests on the north porch, while another carved the Deposition in the N.c lintel, Isaiah and at least one of the Martyrs. As the gangs were being defined it became clear that the next problem was to see if they worked alone, or if they could be assembled into larger teams. Like the masters they were returning to the building many times, and I was naturally tempted to attach them to the building crews, though there were many more gangs or carvers than contractors.

When studying the canopies over the wall statues,[12] and the smaller ones over the archivault figures, I found that most of those associated with the Modeste and Solomon gangs were decorated on the underside with a web of fine

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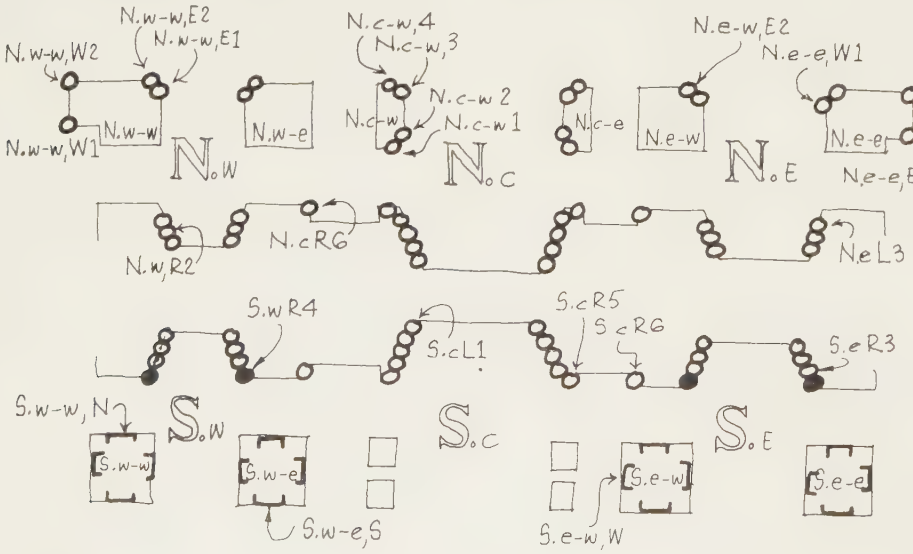
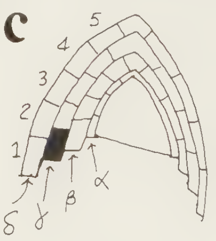
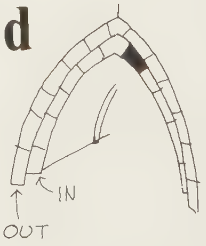
[10] The nomenclature for locating each figure is necessarily complex. The arrangement is drawn below.

- The first letter marks the transept, South or North; and the second marks the door. Thus the S.e is the south transept, east door, the Confessor's.
- Wall figures are marked as so many to the right or left of each door, thus Laumer in the Confessor's door is S.eR4.
- Archivault figures occur in one of five rows distinguished by the first five letters of the Greek alphabet, and the blocks are numbered from the bottom **c**. Thus the horseman in the same door is S.eLγ1 being the left vault, third row, bottom figure.
- The porch piers are located out from the doors, thus the N.c-e is the pier on the left or eastern side of the north central door.
- The large figures on the piers are numbered from the inside, see plan.
- The arches around the outside of the porch vaults are divided into an inner and an outer band, market 'IN' and 'OUT' followed by the side, and the blocks numbered from the bottom. Thus the topmost Contemplative in **d** in the N.e porch is N.eIN,R6.
- Canopies are referred to in the same way, but with the prefix 'CAN'. Thus the large canopy over Laumer is CAN.S.eR4.

Even though a few references may become a little fearsome, just remember to work outwards from the particular door, to the position. In deference to my readers I have kept most of them to the footnotes.







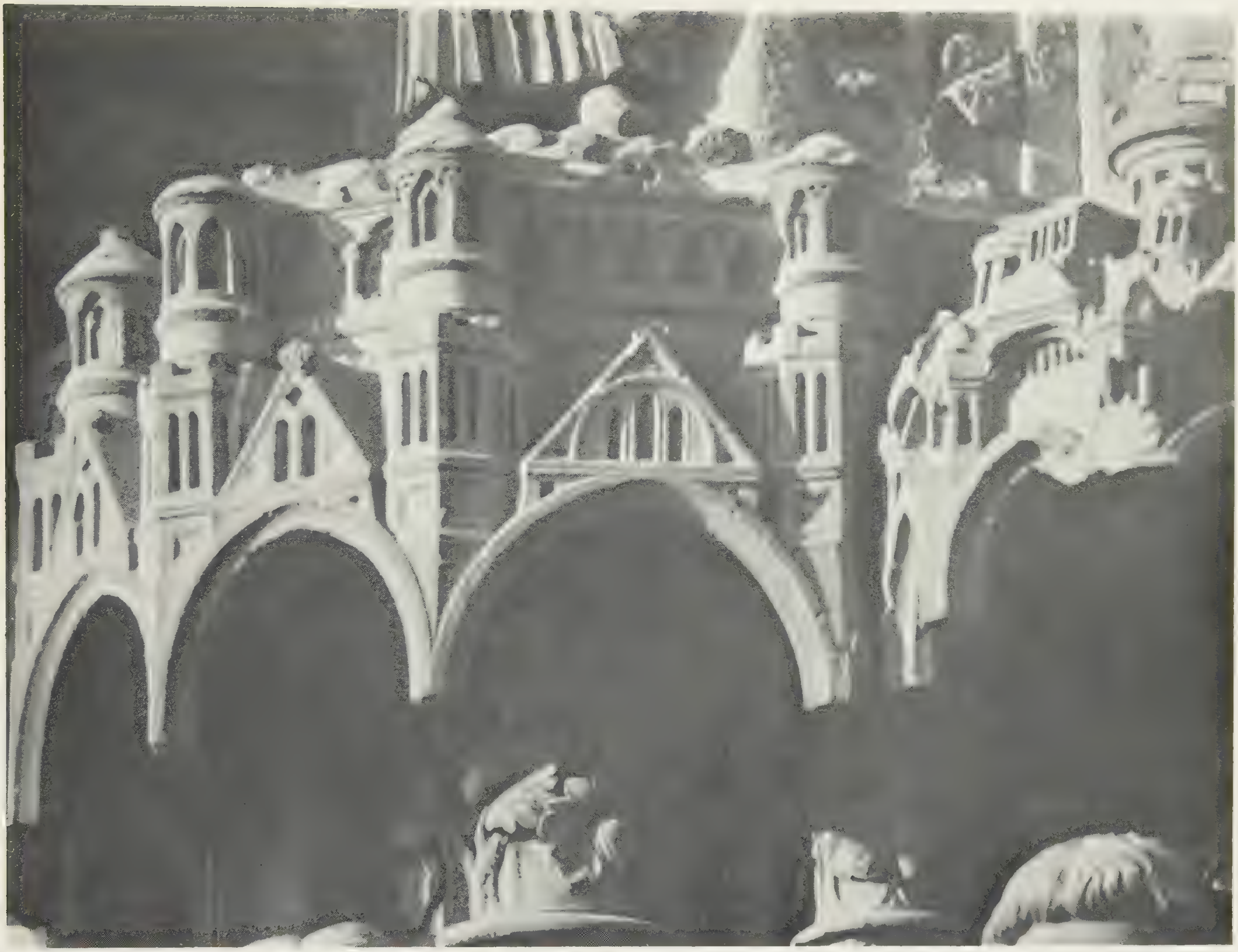
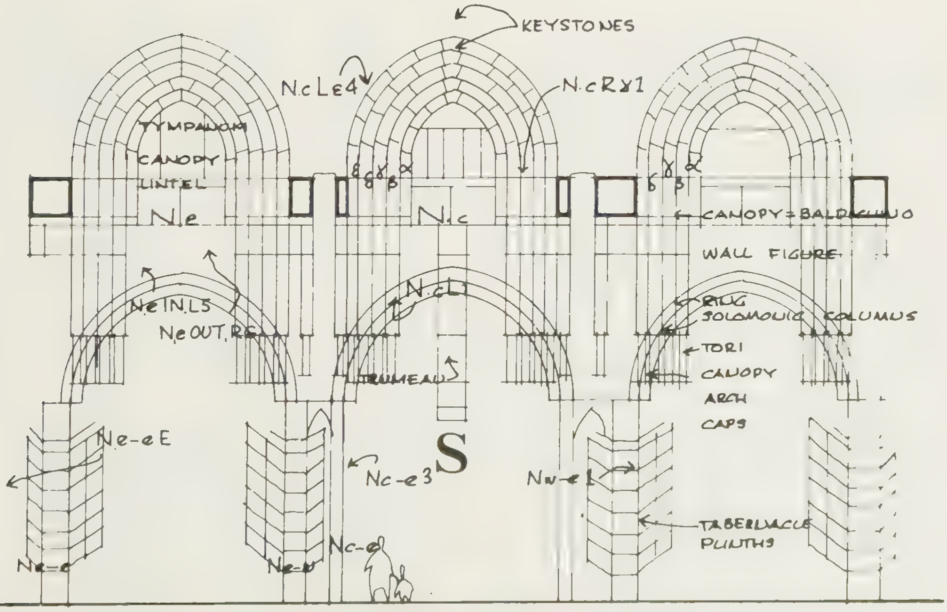


PHOTO 369: The canopy over St. Theodore, S.wL4, by Rose. Note his miniature corbels over the upper openings. Bronze's canopy on the right is by Portcullis.

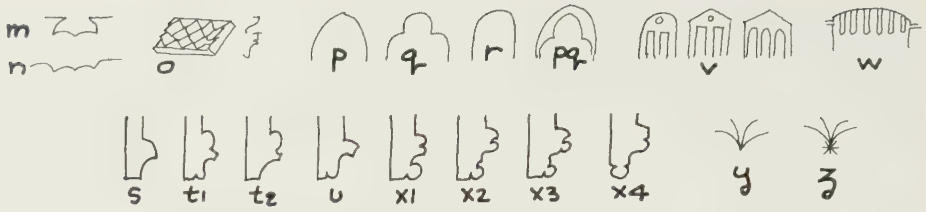


11. See plan n.10. To follow this particular reference, it is the north porch 'N', the west door 'w', the pier on the west side '-w', the sculptures on the west side 'W', the first on the inside 'l': hence N.w-w, W1.

12. *The canopies*

One easily becomes fascinated with the canopies, and the variety of their decoration. I could spend far more hours on them than is warranted, for there is little to be gained in understanding the building from the order in which they were placed as most of them were carved long before they were needed or installed. They do not help to clarify the attributions, yet the fascination remains. It would make a beautiful University thesis, but here I have neither the time nor the space to put it together.

However the general picture is pretty clear: most of them were carved before erection, and were placed later, usually out of order. Some even had to be recut to suit the space left, and



the joints between others are so large that they had to be filled with another stone.

To sort out their makers I used a few simple techniques: sometimes leaves can be tied in with leaves elsewhere, though in this finer stone it is not easy to make comparisons with leaves cut onto the Berchere; sometimes there are similarites in the style of the buildings and turrets which form the cities surmounting them; and lastly from the way the archivault canopies blend into the pedestals under the figure in the next stone.

Some of the cities are remarkably complex, with little windows no larger than a finger, surrounded by a pair of columns themselves enclosed within an arcade complete with its own capitals and bases. Over them are arches roofs, gables and battlements like John's picture of the Heavenly Jerusalem itself. In some cities the outer columns are cut in the round, isolated so that the window moves into the distance behind them. Sometimes only a centimeter in diameter and less than four centimeters high, they are like toys, or a miniaturised Alhambra. The best of these canopies are among the most delicate sculpture in the building. They occur on many of the panels of the southern piers, sitting over tiny arches formed from the most intricate mouldings and often finishing in a leafy bud. Remember when you look at them that they are seldom more than a centimeter across.

Many canopies are scored underneath with radial lines or webbing, starting at the back and moving outwards to finish on the inside of each leg of the arches. Occasionally they meet at a rosette, and the distribution of these, like the range of canopies with isolated columns, shows that it is the idea of Cobalt - a group which can be followed in detail in XI:10. The webbing was also used by Bronze, discussed in XV:25-6 and text.

Some of the canopies have simple sections **s**, usually with uncomplicated arches and regular cities. Complex shapes like trefoil arches are never found in this group, nor do they have drilled openings, nor recessions in perspective. Their towers are straightforward, and are arranged in alternating squares and circles. However, at the end of our study it was not possible to say that one crew carved only the ones with simple sections, and another the complex ones; nor that one crew used the arched canopies over the archivault figures while another sat them on flat plates. Nor can we say that one crew ran webs under them and another invariably cut the inside plain. They tend to be mixed up. The members of the gangs were given considerable freedom in the way they supported the archivault figure, for example, sometimes mixing arched canopies with plates - **G9** - sometimes with simple mouldings, and sometimes with complex ones. The canopy must have been seen as the personal creation of the carver, to be left almost entirely to his whim.

However, there is some unity in the manner of each gang. It is less in motifs, though there are some which are quite personal, than in spirit. Thus Ruby almost without exception used simple sections, single arches, without drilled trefoils or other decoration, and arranged his cities with the same austerity. Cobalt is his opposite, almost always drilling, undercutting, playing imaginatively with his forms and over-decorating his mouldings, in **x**.

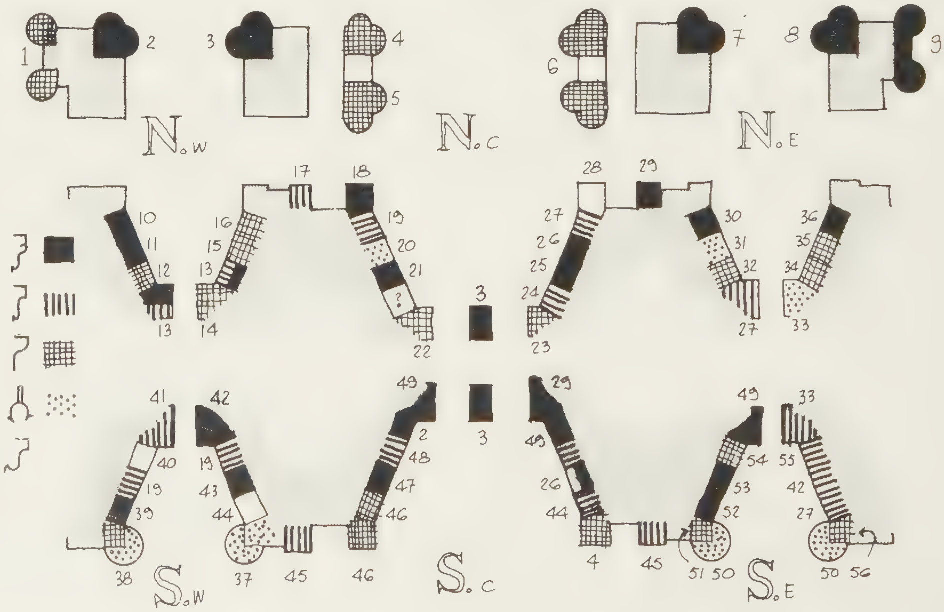
Bronze often used webbing, but otherwise his range of forms is mixed. He liked trefoil arches set within single pointed ones, and the sharp moulding **t** similar to the moulding used in his other arches higher up in the building - XIII:62. Most of the shingled roofs are Brone's **o**, while the simpler undecorated ones are Ruby. The deepest drilling is always Cobalt's. Rose liked complex forms like Cobalt, but lacked his clarity and technical virtuosity.

Bronze liked to group windows under a common opening, Venetian style **v**, though Cobalt and Rose did it occasionally too. It is significant that Bronze should do this most often, as he had begun the double lancet windows in the sanctuary - X:42-4. His cities are more city-like than Ruby's and more varied, as in the portcullis group **w**.

Sometimes a master will mix on the one archivault canopy flat plates, webbed canopies, and drilled arches with plain ones, though on the whole there will be some sort of unity in their height and the proportion they hold to the figure underneath. In many ways, the diversity of design is surprising, considering the importance of the doors and the natural tendency for any artist to look for order. Yet remember we are dealing with 1200, not 1400. The individual exerted a greater influence and was less constrained by the requirements of those above him. Unity was not seen as total uniformity - that was to come later. It was enough for them to follow the general program and the master's geometry and form, for beyond that they were permitted the greatest freedom. Diversity within control. The humanity, the dignity and the ingenuity of the work of this period stems from this balance between authority and liberty. These canopies were studied with David and Kipper Walker.

In the plan the numbers are sequential from top left to bottom right. For canopies in the south piers see XI:10, and for those on archivaults see **G** on.

1. Worn, see heads over shafts, by Cobalt - n.38/N4.
2. *Odrill,* **v, w** or *Brancher,* n.38/06.
3. *Brancher* **q, u.** alternating circular and square turrets, pointed roofs - X:48/h.
4. *Clover.* Branches are thickened markedly as more leave join. **p,q,s.** Berries in crockets, n.38/S4.
5. Framed windows, varied. *Clover?* **p,q.**
6. *Dredge* and others.
7. **p,** n.38/L4, *Brancher,* portcullis type.
8. **q,** ditto.
9. *Brancher,* see text between XI:16-18, **p.**
10. *Squid* **p.** The canopies over the N.w door have the most complex leaves of all. XV:14,16.
11. *Pruner,* **o,q,z.**
12. *Stitcher?* mechanical lobing, **p,t2.**
13. Bronze-L or Ruby-M, *Bustle* or *Frills.*
14. Crocket.
15. *Dredge,* **p,s,o.**
16. Canopy as for 4. Turret on separate stone over canopy, has portcullis **w** by Bronze - XV:14.
17. *Frills,* **q,s** - N.cR4 SOL.
18. *Brancher* **p,s,** simple leaves, thin branches.
19. *Braid,* **p,s.**
20. *Cotton?* **o,r,s.**
21. *Horn?* **p,s.**
22. *Dredge.*



radiating lines like a fan.[13] Often the center was decorated with a rosette. Other gangs may have used the same device from time to time, but never with the same consistency. In the canopies over the Solomon gang, which was turning out to be part of the Cobalt crew, the outside mouldings to the arches were cut with the most accurate and delicate edges and rolls that are quite extraordinary in such a small thing.[14] Tiny three and four-foil openings are drilled through the arches, and it is surmounted with miniscule towers and battlements. Look particularly at the cities he carved over his canopies to the panels set into the piers of the south. They are among the most magical creations in the building.

They carved ingeniously designed cities, with windows often framed in columns which are themselves set inside an arcade of completely undercut shafts only a few centimeters high, and with toy-like bases and capitals covered with leaves and crockets. You forget they are made from stone. You can hardly credit that they have lasted against snow and frost these seven centuries.

Some of these pier canopies are like others over the wall figures,[15] using the same mouldings, methods of drilling, and motifs - though the more complex undercutting in the cities is missing.[16] The canopies surmount capitals over which have been carved some of the most fragile foliage in the building: maples serrated and veined lying across thin branches which bend and twist in the most naturalistic manner; vines and intricately shaped leaves whose branches show where the old growth had been pruned, and sometimes with the bud of the new growth emerging from the old.

Grapes, berries, branches and leaves flutter across the stone, untamed, vigorous with all the spontaneity of natural growth. The same motifs are to be found under other canopies, but without their casual naturalness. Elsewhere the leaves are constrained, forming a symmetrical arrangement on either side of the crockets. They may drill the corners to form intricate patterns, twist the leaves into buttons or even so stylise them that they appear more like fauna than flora. But in the first naturalistic ones there are enough connections to the cities over them, and to foliage carved in other parts of the building, to show that they are the work of Cobalt's gangs. His men approach the very essence of living things. In his pier caps, his bosses and in some of the solomonic columns we find the same unmistakable leaves arranged and cut under the same guidance.[17]

I used the same detailed methods for apportioning the rest of the work among the contractors, but the interlock of these attributions only became clear towards the end of my study. It took a long time to bring them all together and to be sure that the sculptors and builders were from the one crew. The main clues turned out to lie in the smallest details, from which in the end I related gang to gang, and crew to crew right across the building.

Many figures have decorative friezes on their clothes, gloves and seats. They often carry books carved into geometrically arranged patterns of jewels, and on their belts, stoles and shields we find small medallions. These are the small details, yet they have given many of the most important clues. The big statues often stand on crockets or bunches of leaves which we can link with the foliage in the canopies and capitals. For example, take the crockets carved by Bronze under the figure of Jesus ben Sirach, N.wR1.

There is a ball at the end formed from a cluster of leaves. On top are two lobed leaves which merge at the ends, lying over a stalk supporting a leaf with raised edges. berries on stalks decorate either side, and two bell-like leaves complete the underside. The top edge is framed with wing-like forms, which makes a total of eight distinctly carved parts, standardised parts which formed a kit from which he assembled a variety of designs. They appear rather metalic and sharp-edged, lobed in the centre and dished down the middle so that the leaves grow out of stalks folded into gutters without

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23. Lobed leaf of *Dredge?* fine folds on figure, but like 29?
24. *Tips?*
25. *Brancher,* **z.**
26. *Coggles* or *Tips* **r,s** or Scarlet being like 40.
27. *Eyes,* **p,r,s.**
28. **q,s** Scarlet from order of construction, but has qualities of Ruby (angel's hair, hands) and Bronze (drilling, rippling).
29. *Nipple,* **n,q.**
30. *Groovey?* **q,s,y.**
31. *Quercus* **p,t**l.
32. *Dredge,* **q,t**2,**y.**
33. Rose windblown leaves, or Ruby? See X:54 & 5/q.
34. *Helmet,* **m,q,t,y.** Crocket leaves grow out of branches which twist over one another.
35. **p,s** mechanical lobing, *Stitcher?*
36. *Horn,* with panel to east - XI:14/n.
37. Rose corbels in windows, **q,x3**. Copies **y** in others, but this is the only time - X:56, XV:25.
38. Rose, with squares between windows.
39. *Odrill?* **p,s** - Portcullis **H**15.
40. **p,s** with pebbled corners like Scarlet's S.c δ, ε 2 - **G**2.
41. *Frills.*
42. *Eyeball,* **p,s.**
43. *Odrill,* **p,q,** densley packed leaves like S.OUT canopies by Bronze - XII:10.
44. *Plane,* **p,s.**
45. *Eyes, Curley, Flap,* repetitive windows, **q,s** with panels XI:14/a & b.
46. *Helmet?* **p,r,s,y.** Motif also used by Ruby, WN.II(t) cornice and WS.V↓.
47. *Brancher,* **p,q,y,** drilled columns like S.OUT.
48. *Tips,* **p,s** like under statue S.cL2.
49. *Odrill* on west, *Dot* on east.
50. Regular windows. See N.cβ keystone, **K**14.
51. *Clover,* **m,p,q,y.** This is the canopy with the embryonic bar tracery discussed in XV:26.
52. **q,s** byzantine domes.
53. *Pruner,* **p,s.** See similar columns in S.eR3 OUT Canopy in XI:10/w.
54. **q,x**4,**y.** Drilled windows, separate columns like south pier panels from gang 1 master d - XI:10.
55. *Eyeball,* **p,s.**
56. *Clover,* **p,q,t**1,**y.** Note leaves round impost, n.38/J2.

[13] Also 'Lierne' ribs in XI:10/y and XV:26 and text.

[14] n.12/x.

[15] For description of S. pier panels XI:10.

[16] As many of the canopies had already been cut by earlier teams to a simpler design, I think Cobalt may have simplified his in sympathy.

[17] Comparisons are not easy to make as the canopies are cut from a fine-grained stone, and the capitals and bosses come form the hard Berchere. See XI:19 for caps, XI:34 for bosses, X:51 for solomonic columns.

veins or ribs. These lobes are shaped like tear drops which form cusps against one another creating the most beautiful cateneries.

The same limited motifs are arranged with the same feeling for their rhythmic ebb and flow in some of the carved panels under the north piers, and in some of the sanctuary bosses.[18] Each time it occurs within a band which architectural evidence ascribes to Bronze. So these leaves must be by one of his men, and thus the crocket under Jesus ben Sirach must be Bronze's too, thereby linking the statue itself to one of the gangs in his crew.

However there are many kinds of lobed leaved. Not all of them can be ascribed to the one gang. Some of the items in this kit are used by other crews, but none have the same metalic quality, nor are they arranged with the same unnatural abstraction. Rose uses a few of these shapes, but more softly and with some of the rhythm round the edges also found in his drapery. Both gangs reduce the leaf to a simplified shape, and the only way to distinguish between the cutters is to examine the way they handled each item, and how they assembled them. The kit itself seems to have been part of the repertoire of fashionable motifs of 1200. As in other things, the individual is to be found in the way the form is handled, not in the form itself.

So I filled my cards with all the motifs used by each gang, in sculpture, leaves, in the shape of the cities and so on. I again began to arrange them in as orderly way as I could. The first order came from the necessary sequence in the tympani and archivaults. The second came from the architectural program, for the archivaults for all three southern doors had to be finished by the time Bronze-L began the buttresses over the porch roof. The final date before which all the work in the south had to be carved was 1205. I needed at least eight campaigns to carve it all, so it must have been started with the first courses in the transept in 1198 or'99.

This showed consistent links between the carvers and the builders. They would seem to arrive with a certain master, leave with him, and come back years later at the same time. When I expanded the connections to include the gangs working on the leaves of the capitals and bosses the same gangs continued to return with their master right through the cathedral. Long after the doorways had been finished the masters were using the same carvers each time they returned. If I needed proof that the sculptor was a permanent member of the building team, I now had it - in the solid dossiers for the sculptural work of Bronze, Ruby and Cobalt, and less solid ones for Rose and Scarlet. I used them to help apportion the later work in the north and in the outer parts of the porches, and this is explained in the notes to the porch drawings spread from Bronze-E in 1198 to the last archivault carved by Scarlet-O in 1209. Just twelve years for all the door sculpture, and another eight to finish the northern porch. Not long, was it?

As I began describing in chapter XI, the crew is made up of a number of gangs who seem to retain their independence in many matters. The teams were not like hives of bees whose workers were merely extensions of the will of the master, obeying him in every thought and action. Great humanist architecture and sculpture is not produced in this way. Naturally the master's authority extended over all the major decisions, including all architectural design and geometry - though even here I have some hesitations which I shall describe later.

His authority seems to have extended to encompass the form of the capitals and panels of decoration, and his influence (or that of the crew-as-a-whole) pervaded the general feeling of the sculpture. In a community which is

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[18] See III:39/H for pier bases and XI:34 for bosses.

THE SCULPTURE OF THE PORCHES - detailed analysis

These notes are a shorthand of connections, for it is not my purpose to write a book on the sculpture. I have noted only the more recognisable items, and have written them in the shortest way possible. No apologies, for I know that to do the sculpture justice requires more than a few footnotes. These comments are largely architectural in character, and are directed towards elucidating the overall architectural problems. It is up to those who understand sculpture better than I do to cover it more fully, and to put it into its own context.

The numbers on the drawings begin in the S.w door and work their way across the page to the right, then down to the north porch beginning again on the left with the N.e door. Hence in the text I can often quickly locate a statue by its reference on the drawing.

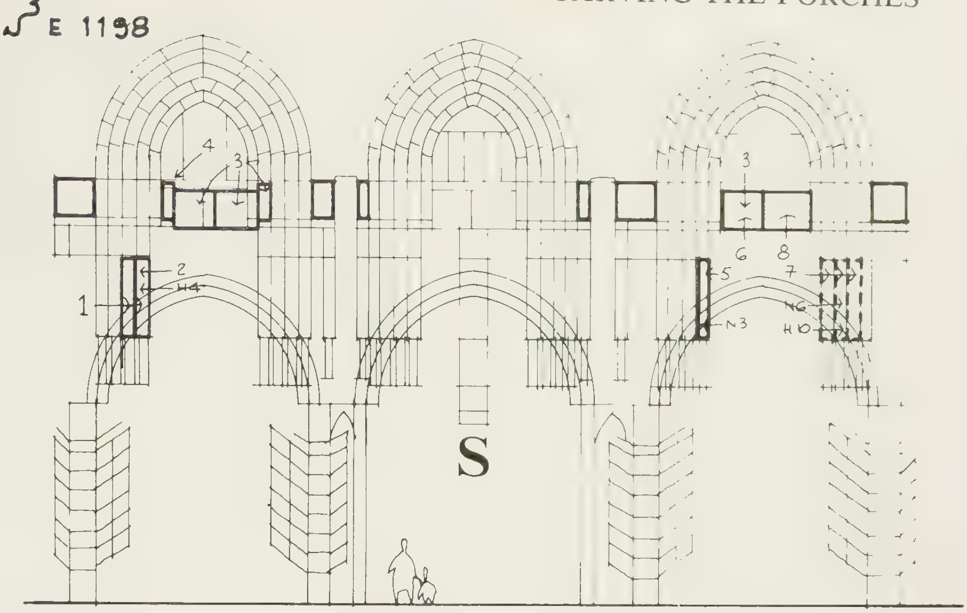
Naturally I am uncertain about many of the attributions and even more uncertain about the date of carving, but I feel if I labour every uncertainty I will only add to our perplexity in what is one of the most difficult parts of the cathedral, without adding much to our understanding. Sculptural analysis is such a personal matter that much depends on feeling. Where some crews like Ruby and Bronze have returned many times I have placed the carving of their sculptures into those campaigns which suit the natural erectional logic of the doors, even where work was precarved and stored. Where there is no such logic, as in the wall figures, I have let my feelings dictate their evolution. I have come to understand the work of those masters who have worked here many times better than the others - being Bronze, Rose, Ruby and Cobalt. There are a number of items, particularly in the earlier and the last campaigns, that may be attributed to the wrong masters, or may even be by outside workshops.

BRONZE-E, 1198

1. Ears of both figures have the same plain lobe and scooped centre. Surface lightly polished as in N.cL5 and R5, see **O**2, 3. Lower edge of dress bounces out, see also S.eL β1 and δ2. Further discussion **H**1.

2. Beard highly stylised and layered as in N.w-w2, Potentin. Eyebrows, clothing, patterns on cloth. Figures are without movement, with same hand and body position. Bottom drapery is stiff and encases body.

3. S.w lintel is an assembly of figures with little artistic cohesion. Yet style of drapery, particularly the folds of the tunic over the belt, is that of the N.c right lintel (Bronze-H), in the right half especially. Good ears, careful natural hair with twists and curls. Notice the short upper arm in all of them. These are the characteristics of many of the men in this team



- see Potentin, Modeste on west side N.w-w, and in N.e-eE1. Also the rounded elbow. For connections with Red see n.38/T3. Compare with S.wR α1 - waist, ears, nose.

Kneeling figure in lintel like S.eL δ1, in **H**13. Fine cloth, the form and cut of hair, stance. Many things in common with S.e lintel left, particularly the figure on left: kneeling with flattened folds as if formed in smooth clay like the thin folds of S.e upper tympanum (Bronze-H), and like S.wL β1 and δ1 with the ends of their clothes billowing like **E**1 and S.wR β2, and perhaps S.eL β1, though I have preferred Scarlet for the last one - **G**12.

The master of this lintel has the same stiffness as we find in the big wall figures below, however see n.29.

4. Uneven hem common to many Bronze men. Stone is the same height as R α1. Both α1 stones are shorter than those in the adjoining arches suggesting different campaigns, which is why I placed them here.

5. Same diamond pattern in clothing as in '1', the cloth whips out at the bottom. Face closer to N.cR5, in **O**3. I could place this figure with a number of teams, but prefer Bronze for the face, edges of cloth and the 3-leafed crocket by *Pruner* under his feet. The ear, nose and eyes are his as in N.cR5.

However there are also connections with S.eR1-3 figures - hemline, facial structure, and the technique of arranging the major embroidery within a plain frame which is itself a decorative device.

6. The left half of the lintel is smaller than the right, suggesting that it was cut at a different time - though the high head of the horseman suggests otherwise. The difference in the two heights is taken up in the Portcullis canopy, **H**15. I gave it to Bronze for it has affinities with some of his other work, though it may have been Rose or Olive.

I find that these two lintels and their adjoining statues are particularly hard to unravel. They have only tenuous connections with other parts, and so need not be by the Bronze-Rose-Ruby-Cobalt combinations which did most of the work on the porches. The later work by these four has turned out to be much more firmly solved than these earliest lintels. Were they carved by freelance artists?

7. I place these three figures here only with the greatest trepidation, for I really prefer Rose-C, on style and on their size.

In other doorways the wall figures just touch, or are slightly twisted so that their overlapping does not disturb our view of them. They tend to be thin, from back to front, and as they are widened they twist so that when erected they will bypass one another. The sculptor's problem was to create the most forceful and real impression possible, without projecting one figure too far into the air space of another or into that of the doors. The problems of the twist in the N.w I discuss in **N**3 and **O**6.

The thin quality of the S.w door is because many of the right hand figures are 30 or 40 mm. apart. The apostles in the S.c just touch. But in the S.e the Confessors not only scrape one another, but the shafts on which they rest have been pushed outwards over their supports. The R1 figure has been moved to the left, and the R3 to the right expanding the space by about 180mm. On the left the space has been enlarged by only 60mm, as two figures were carved later.

The alteration is not noticeable for the canopies have been set over the centres of the statues. The R1 canopy is pushed into the door jamb, the centre one has been twisted over and the space filled with a small turret, while the R3 was moved well to the right, and against it they fitted a new piece of stone. The necessary damage to its right face is covered with render. So the Confessors could only have been carved for an embrasure with wider centres between their supports. They must therefore have been carved before the stepped stones of their bases were set up by Bronze. This is borne out by the heights of the figures in the S.e embrasures which are on average 120mm taller than any of the others in the side doorways (2,220 v.2,100 av.) as noticed and measured by van der Meulen, 1970, p.535, n.58. This does not necessarily mean that they were carved for another place as he suggests, but just that they were carved for a slightly wider and taller embrasure than the one actually built, and that they would therefore have been carved before 1198. Olive is one choice, Rose-C is another and, more appealingly, Scarlet-A himself. Perhaps they had intended to omit the flanking fluted columns as at Sens, or perhaps a raised socle as at Amiens and Paris. If Scarlet did carve these figures, then sculptural work began with the first campaign! If so Bronze in campaign 'B' could have carved the smaller lintels in '3' and '6' with the smaller adjoining archivault '4'. This would bring both Olive and Rose into the picture for '3'. The wider Bronze Confessors in S.e could also have been carved in campaign 'B', before Rose reduced the width of the doorways by reducing that of the transept in GEOM:VIII-A. Then the thinner figures would cone later as the doorways were replanned for the smaller front. Similarly with the other half of the S.e lintel in '8'.

Most authors have linked these three, and have tied them in with some of the archivault figure above. I would also link them with S.wL4 & R4 figures, particularly the Jerome S.eR2 with his beautiful hands compared to S.wR4. S.eR3 uses Bronze's *fleur-de-lis* pattern (S.wL4, R1 and north pier panels III:39), both have uneven hemlines with similarly scooped cloth, which is not thick like Laumer, nor thin line Modeste.

Note particularly the intricate wavy lines on their hems, deeply cut in underneath, and with deep gaps between the folds which are often wider inside than at the face. This technique is only to be found among the Bronze figures, including S.wR4, and his wall statues in the north. Similarly the eyballs of many of his figures stare (see S.wR4 again) and from below their features are similar.

The back of the shield of S.wR4 has the same stylised metallic leaf as is found under the table of the support figure to S.eR3, and on the sleeve of S.eR1 - yet consider **H**3 & 4. *Horn*-like pattern is also found in his north 'arcade' - also there is another typical *Horn* decoration under the support tables of S.eR3. The links are strong with the base of N.wR1 (Bronze-O) and with the S.wL4 canopy (Cobalt). Above all notice with these figures the carver's love of strong intricate patterning.

8. The eyes are small, the hair wavy which suggests the kings over the south porch and some S.IN - so by Bronze. The lying figure suggests Job in the N.w tympanum, **P**5. The clothes are like the N.e tympanum, **H**11, 16. For these reasons I put this with the Job/Elevation gang. See also the N.w tympanum wife on the right, and check out the wavy hair and features of S.cOUT.R6 in **L**1. This note is not consistent with '6', so was the latter by another?

both feudal and free there would be little sign of the structure behind commercial authority and communication as we know it. The influence of the different personalities in the crew, and the rapport each may have had with the client, and their empathy with the work left by preceding workmen, are certain if incalculable forces. But some relationships seem to come through clearly. Beyond the major matters the master left many more of the detailed decisions to his men than we would today. The foreman's influence would have had a more profound effect on the work than we would expect, for at times he had the right to arrange all the decoration on the bosses and capitals, to subdivide the panels for leaves, and perhaps even determine the way the sculptural figures related to one another.[19] As there are many gangs in the crew, the decorative carving and the sculpture will be more varied than the architecture as the decision-making process is more wide-spread at this level. The great variety of sculpture is a function of the number of individuals involved, both foreman and masons.

There is no doubt in my mind that many, if not most, of the sculptors were members of the building team, though there were probably a few roving exceptions. To employ specialist teams of carvers seems to contradict what little we know of their ways. I think that most scholars would support me in this. Simson wrote that "the sculptors partake of the 'noble simplicity and calm grandeur' that truly characterises the architecture as a whole - so much so that we cannot doubt that sculpture and architecture are essentially the work of the same artists. What this affinity of style suggests is confirmed by our knowledge of medieval building practice. The master who directed the building of the cathedral was also in charge of its entire sculptural decoration. And he was fully qualified to assume such vast responsibilities. The medieval builder had passed through the same school as did the stonecutter and the sculptor. The apprenticeship of all began in the quarry. The quarryman and stonecutter became a 'freemason' ..... The best freemasons created the statues of the facades; the best among those rose to be master of the fabric and leader of all ..... Even as he directed and carried the tremendous responsibility for the great work as a whole, it was still customary for the master to take an active hand in its execution."[20]

Medieval society was not unlike many less centralised communities today.The modern individualistic art of the west, from which standpoint we tend to judge the past, is founded on the artist's concern to develop his personality so he may create an easily recognised and personal style that will lead him to his ultimate goal of recognition and fame. It was not until I had lived outside our own culture for a while, on the small island of Bali, that I began to understand the way medieval art was created. Miguel Covarrubias in his magnificent book on a culture which was, before the war, still largely uncontaminated by the western egocentric tradition, wrote that "the anonymous artistic production of Balinese, like their entire life, is the expression of collective thought. A piece of music or sculpture is often the work of two or more artists, and the pupils of a painter or a sculptor invariably collaborate with their master. The Balinese artist builds up with a tradition of standard elements. The arrangement and the general spirit may be his own, and there may even be a certain amount of individuality, however subordinated to the local style."[21]

With this description of their ways ever uppermost in our minds, let us examine the work of the gangs in just

[19] See Bronze bosses, and discussion in XI, where all those in the nave were cut by one gang and follow almost the same pattern, while the few in the sanctuary done later in the same campaign by another gang are all individually designed. If the master had had complete control there wouldn't we expect a consistent policy towards the design of bosses?

[20] Simson, 1964, pp.219-20.

[21] Miguel Covarrubias, "The Island of Bali", London, 1937, p.164.

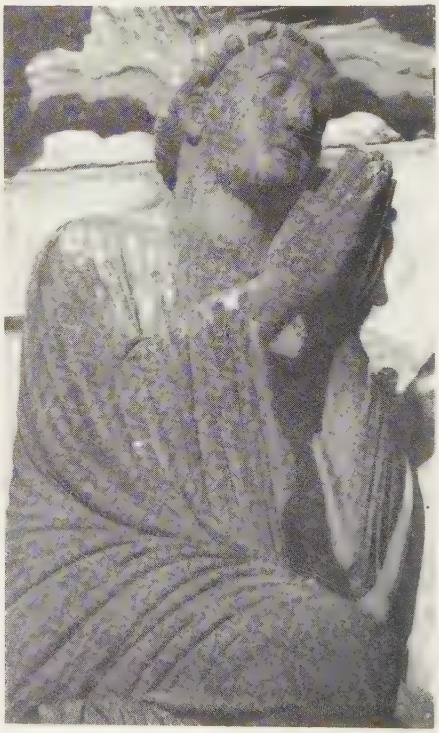


PHOTO 374: The figure of St. John in the S.c tympanum by Ruby. The head is characteristically Mumps. This gang is discussed on p 380

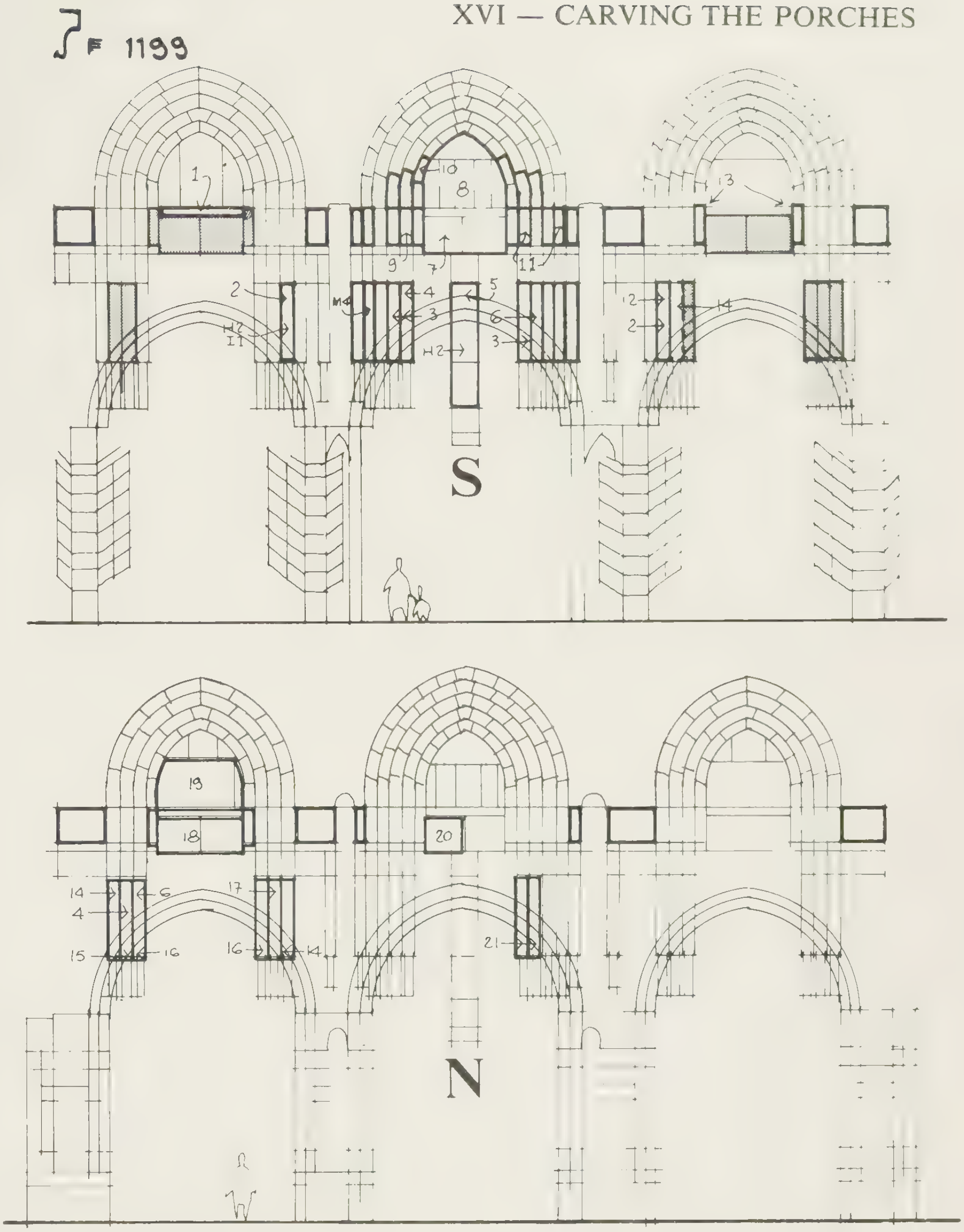
RUBY-F, 1199

1. The lintel was carved before the canopy over it because the shape inside the one is not like the other - n.8. Further the top of the canopy is higher than the immediately adjoining archivault stones, but is the same height as the other bottom courses: so we can say that the latter were built with or after the canopy. Notice Ruby's typical clouds, formed in regular even patterns, and the edges cut into simple curves.

2. Has the eyes, ears, eyebrows and loose fingers of N.cL3 in **M**4. Vestment patterns like S.eL3 in **F**2, 12. The vigour of the hair, and firm nostrils are of the Forker family. Ears are set low. He loves tendons and veins which are shaped into interesting curves.

3. The basic similarity between these figures is discussed in the text, and the interconnections between the gangs can be followed in n.22. Best motifs were their clothes and the little figures underneath. Leaves under L2 by *Braid*.

4. The hair twists out to a point like whip-ice,



as in N.eL2. Compare with S.wR4 where another master turns the ends of the hair back into the centre of each bun, like a knot.

5. The intricate pattern on the covers of their books is sharply and deeply cut. In Christ's the frame round the cover is interspersed with halved circles also found in S.cR6 in **I**4.

6. The pattern on the book is like N.eL1.

7. The figure of Louis under Christ is the same, and has the same flowers in his hair, as the Louis in the S.c tympanum, n.2.

8. The connections are described in the text: 3M gang. Note the clouds, and the simplicity of the wings of his angels, unfeathered and projecting out of their backs on long stalks. Where they are feathered the grooves marking them are short, and the ends square. Relate to some of the Saved in the right lintel, and to N.eR2 etc.

9. Abraham is from the Forker gang. Notice how few raised eyebrows there are in work by other gangs.

10. Same thick ankles, and the same column-like legs as the Saved.

11. Connections with the lintel, Forker and 3M are obvious.

12. Has the head and eyes of the N.c Tympanum. Note the peeping foot; the pattern of the scoopoed 3-foil leaves on the back of the glove and the *fleur-de-lis* of the S.cR6 book. The pattern of faceted diamonds is like the S.wL group but with sharper raised edges and a metallic feeling. I think they were adapted from the carefully cut patterns Bronze-E had carved the year before.

13. The hair and brows of Forker? Uneven hemline of Bronze? Both stones are lower than the canopy over this lintel, so they are before Bronze-M who carved the Portcullis canopy, **H**15. Clothes of N.cR3? Head of S.wR3?

14. Clothes of Forker, yet its support figure links it with N.eR3 where the clothes are by Stretcher. The beard is close to S.eL2, as are the eyebrows, thick hair and hands, and it has the same base, animals, hair and foot posture as N.eR3.

15. The hair, beard, and ear of S.cL1, the cloth of Forker-Crown. The support figure of the devil is precisely that of S.cR β1: the broken nose, square teeth, jutting eyebrows and long pointed ears. Does this master later do the animals under the leaves of the N.c gable given to Scarlet-Y in n.38?

16. Under both Virgins were carved the same unmodulated leaf and berries, with scooped branches. The hands, clothing and face show they were both by the same gang.

17. Stretcher's clothing, like S.cL6 in **I**4.

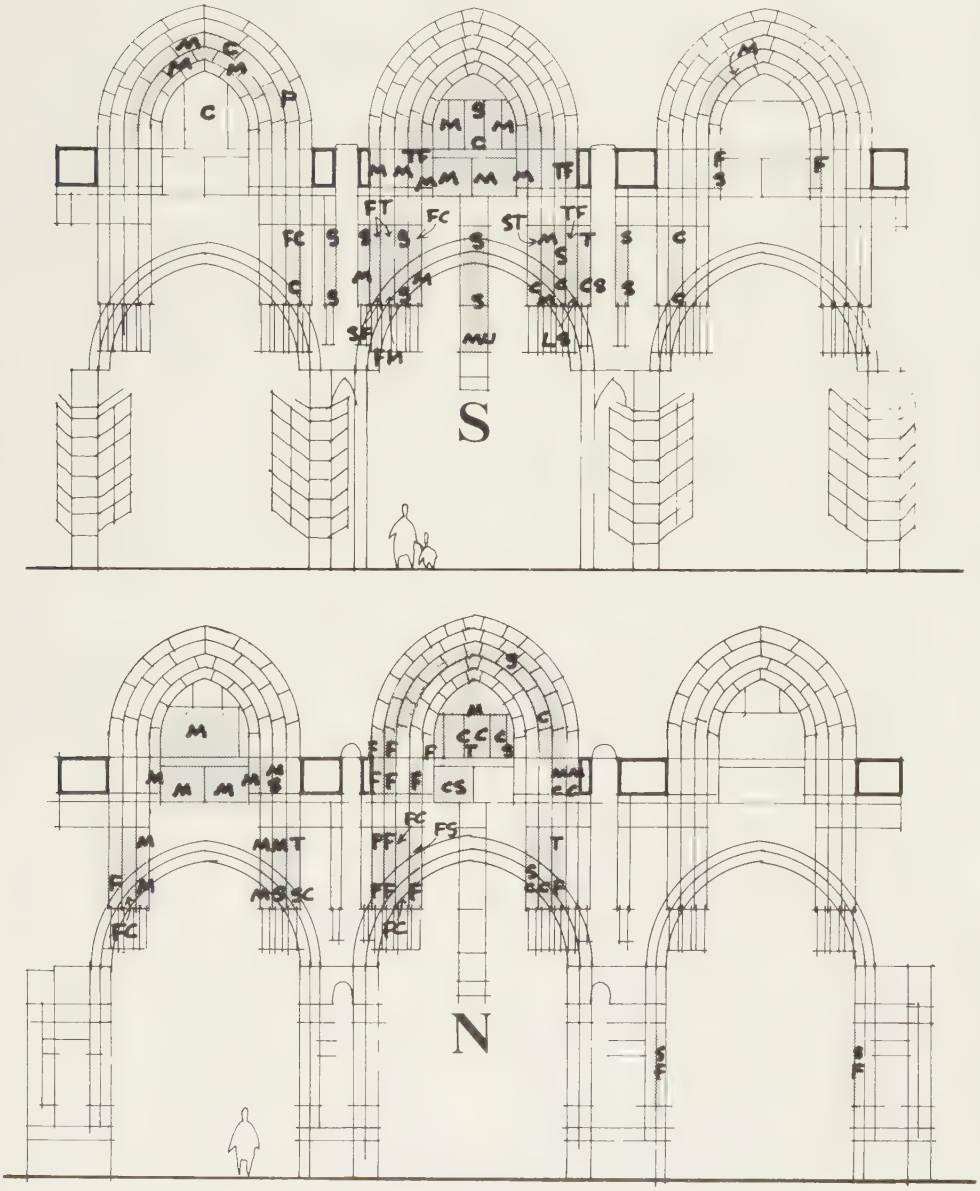
18. The round faces of the 3M gang. Mumps figure on the right. Angels and clouds all typical. The vines on the right are like his north pier panels in III:39, but from the shape of the recess in n.8, and from the spacial quality maintained between the figures could this stone have been begun by the Bronze gang in **E**3?

19. We have a similar problem with the lower stone of the tympanum. The three heads appear Moonish, but the three figures on the bed on the right seem, in posture and in cloth, to be closer to Bronze as in his N.eL γ3 in **L**10. The frame around this stone is also a Bronze type - n.8, so I think that Bronze began it, and Ruby had it completed. Scarlet then built the upper tympanum stone with the first archivault - **G**16, 17 & 18.

20. I am tempted to give this half of the lintel to the Crown master, or to Stretcher on clothing and stance. The lack of heads poses problems, of course; but the two of Mary, one on each half of the lintel, were preserved. Superficially they are the same, and the slight differences may indicate two cutters rather than gangs. As with the two Christ figures in the south one is clearly modelled on the other. Were they under instructions to keep the two faces of Mary in the one door the same? However, the different arrangements of drapery, stance and stone heights tempts me to separate the two halves of the lintel, to give this half to Crown, and the other to Bronze - **H**18.

21. These big figures are clearly linked to the left lintel - notice the identical head at the back left. However, though most of the connections are with Ruby, some hark to the right half of the lintel too. The common factors may be sympathy on the part of the later Bronze gang in the right lintel, or to one crew working over or finishing the work of another. The leaves under N.cR2 are *Lobby*. The little figures under N.cR2, 3 are like S.cR6 in stance, broadness and humour - **I**4. N.cR3 is linked to Stretcher in the head, and to Forker in the clothes.

one of the crews - Ruby. Ruby employed four gangs on his sculpture, though I suppose I should have more hesitation in calling them gangs rather than collections of individuals. I group them subjectively from the way they share a number of common characteristics rather from the dubious conclusion that they worked together. The drawing shows all the work done by this crew, split among the four gangs.[22] These drawings are diagrammatic, and are not to scale. The outline of the porch piers and vaults is set just below but overlapping that of the doorways. The letters refer to the four gangs called Stretcher, Forker with two more recognisable hands called Thomas and Curley, Crown and the group I call 3M in which we can distinguish the three hands of Moon, Mary and Mumps. More than one letter appears on each statue as Crown characteristics may appear on the clothes under one of Thomas's figures, and Forker's viscous



22. *The work of Ruby divided among his gangs, is indicated below left.*
S is Stretcher, F is Forker with two identifiable carvers Thomas FT and Curley FC, C is Crown and the 3M gang with Moon, Mary and Mumps, who have not been separated on the drawing. See detailed analysis of work by each master between pages 317 and 393.

SCARLET-G, 1200

1. The woman is like the wife in N.wL γ1, and there are similarities in the leaves and the cap, though can we connect it to Bronze through N.wL1?

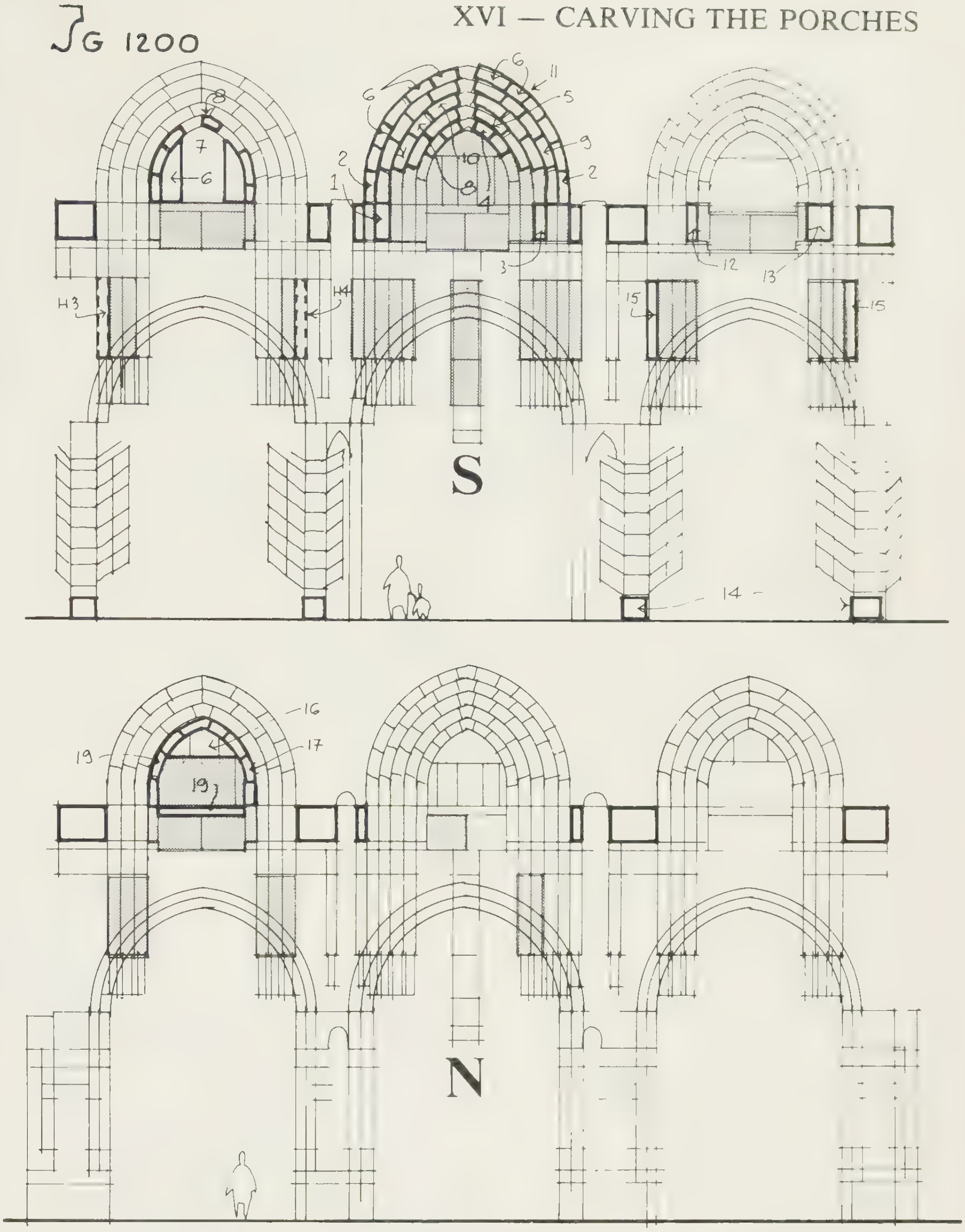
2. The outermost 'saved' rest on rusticated canopies with the underside decorated with webbing. Webbing was not used by Ruby - n.12 - and the rustication seems to be a Scarlet motif - n.12/40. The clothing in these figures is un-Ruby, for it follows the form of the body, clinging to it and enlivening it, while Ruby cloth has a density of its own. Scarlet's nudes match the others, but his details are a little finer. It is a good example of the sympathy shown by one man in adapting his style to create a unified field.

3. I do not have enough work from this crew to be certain of his style. This is a short campaign, and I have been tempted to include a number of odd-men-out in his group. The S.cR γ1 figure, with its soft delicate cloth is one example, for it does not fit Ruby, is closer to Bronze in N.c-w2, yet fits only Scarlet in the building work. As independant workshop?

4. Similarly the upper α angels with knotted scarves blowing in the wind are more like the Bronze-Modeste gang's angels in the S.OUT, yet the rest of the figures are like the others I have given to Scarlet.

5. The upper β figures with long bodies, whose clothes have thin edges and oft-broken folds, remind me most strongly of the two tympanum angels in the S.w. I have given them all, as a group, to Scarlet, for they have similar wings not to be found elsewhere. Also, considering Louis' donation, it would not be unreasonable for Scarlet to have hurried to finish the S.c door in the same way as Ruby had concentrated on the earlier parts.

6. The wings carved by Ruby are plain, with perhaps one row of blunt-ended feathers. Bronze used many layers, separated each feather, and gave them points. Scarlet's tend to have ragged ends like an eagle's, and curve outwards or are windblown. The upper ends of his wings point in towards one another like horns. Some have a distinctive little feather halfway up each side which points outwards. The feathers were studied with Dee Mitting,



and those we gave to Scarlet are marked on the drawing in the S.w and S.c.

7. The S.w tympanum is cut from three stones. The outer edge of the two flanking ones have been cut back at the top, altering the shape of the arch, and lowering it. The change can be picked up halfway up the inside archivault. The inner side of the two flanking stones looks as if he had intended to construct a canopy over the central figure - but that figure of Christ is not only out of proportion to the angels, but the inside curves above his head are twisted so they will be aligned with those in the flanking ones. Hence, from the change in arch-shape, and the alteration of the inside curves, I think the side stones were cut first, and the middle one was done later by Ruby-I, for it has all the hallmarks of the Crown gang.

However, the angels have many similarities with some of the Ruby work (head, full cheeks, close-fitting drapery, lack of movement) so they could have been cut by Ruby-F, the outside curves altered by Bronze where he carved the first row of archivaults, and the central panel done by Ruby later. Because the scale of Christ is so out of proportion to the angels I prefer the attributions I have given.

8. Top figures are like S.cL γ4, showing that the whole of an arch was not necessarily carved by the one gang.

9. Many figures sit on flat plates, rather than on arched canopies.

10. S.cLl γ5, 6 have the same flying cloth of some N.w δ figures carved by the same crew eight years later, **P**1.

11. One or two of these figures could be Bronze (L γ6, L δ4, and R γ3).

12. There is a second Scarlet gang whose figures are solid and sure, where they tried to reduce all clothing to its simplest with few creases, which can be connected to the N.w δ. The cloth is gashed to express the essential form of the person.

S.eL β1 is like N.wL δ5. They have a radical approach to drapery in which everything is reduced to the uttermost simplicity. Strong cutting is contrasted with large unaccented areas. This gang worked on the Tobias archivault in the N.w δ in 1208, and on the N.cOUT Creation in 1215 - n.38/V1,Y2. The same approach to cloth can be seen throughout, though with the changes we should expect with time. See also S.eR β1, α1.

13. The two immensely simplified figures on the right are formed just like '12'. The head of β 1 is 'wigged' like many in the S.c. The figure of the priest before the altar in its magnificent simplicity is worthy of more attention than its location stimulates. In the king the cloth is draped against the wall as in N.w δL2.

14. Began the south piers with his foot unit and geometry - GEOM:XVI-A. Hence the decision to add the extra figures in the side doors is his, or perhaps Ruby's, if made late in his campaign. See text.

15. For this reason, and because of the massive way he handles cloth, I have placed the two extra saints in the east door here, though I would have been happier with an independant, or itinerant sculptor.

They are both by the same gang - cloth between the collars, the sideways folds in the drapery whose scooped ends overlap one another, the full lower lip tucked in at the sides, the full eyeball tailing into the corner, the big ears with a plain triangle on the inside. The bases under them are the same, as are the patterns on the clothes. The acanthus on the end of the stole is like some Scarlet leaves by *Zulu*.

The latter plus the folds links it with some of the N.cOUT, however I do not consider the links strong enough for us to be certain. Some of the Rose figures in the S.e ε have similar drapery, eyelids, ears etc, though this could be from the powerful influence of these figures on later sculptors. However, if they are by Rose it would help to explain **K**12. One, and maybe both the extra saints in the S.w may also be his from **E**7. See **H**3, 4.

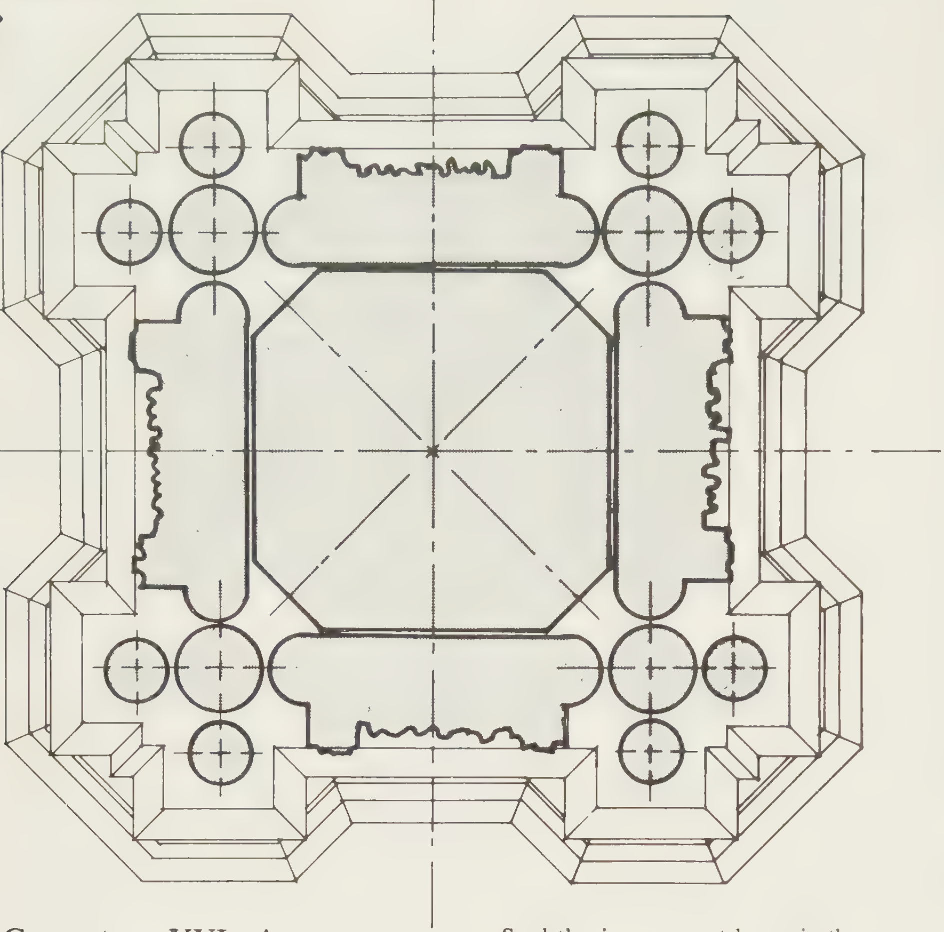
16. In the N.e upper tympanum the angels most resemble those in S.w α. Fine detailing in the canopy is like his arrangement for the south porch piers. This helps to clarify the earlier carving of the stone below.

17. Angels in N.e α have one wing twisted behind them, the clothing has dramatic simple and heavy folds, good hands, and with the fabrics and faces of S.w α in '8'.

18. N.eR α3 same as head of N.wR δ3.

19. The angels under the canopy are his - roundness of forms, drilled leaf on the capital, and their hands.

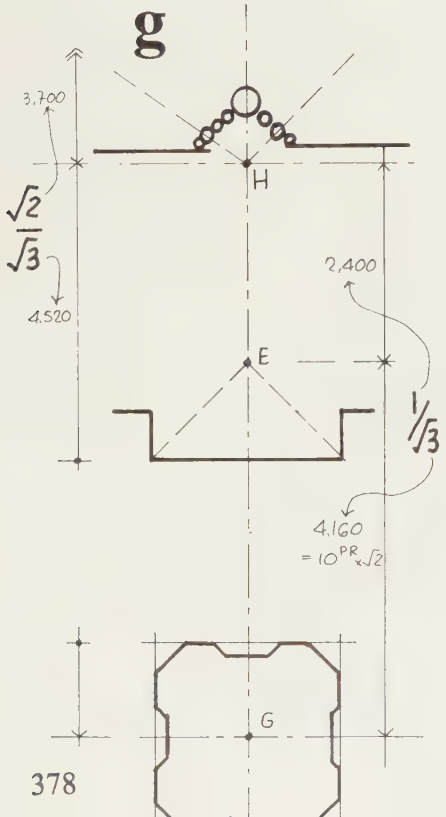
f



Geometry XVI - A

The piers of the south porch, Scarlet-G, 1200

g



Scarlet's piers were not begun in the same simple way as Bronze's in the north. Where Bronze's were massive and simple, Scarlet's were highly articulated, as you can see in the plan **f** and the PHOT , and give little feeling for either the loads they are carrying or the thrusts. If Scarlet had not originally intended to have porches - ISOM-A - then I can see why he designed them in this way, for they would then have stood beyond the 'essence' of the building. They would have been non-significant, and so just *cosmetique*. The rest of the cathedral was built in the most substantial manner, and to establish the added nature of the porch Scarlet treated it as pure decoration. It is one of the most fragile architectural structures from this period, and only makes sense to the extent that it stands beyond, and irrelevant to, the cathedral itself.

Scarlet is certainly the designer, for its geometry is based on his foot units, his squares and diamonds, and his harmonics. The doorways had nothing to do with him, so he began by measuring the distance from E to the epicentre H in **g**. Using this as his base length he calculated the space to the centre of the pier G as $\sqrt{3}$ times it (2,400:4,160). It 'so happens' that the space is also $\sqrt{2}$ times 10^{RF}, while the interior space to the centre of the bay, shown as 3,700mm on the left of the drawing, is $\sqrt{2}:\sqrt{3}$ times the mass of the wall beyond the axis (excluding the space of the porch) to within 12mm - using another favourite ratio.

Around G Scarlet composed a perfectly symmetrical pier, starting in one of these three ways: firstly in **h** form three circles of 3,6, and 10^{PM}. From them form two squares and a diamond. The outer pair will form the outline for the base, while the inner one locates the four larger shafts to the pier. The measurement of the outer square is 2,120mm or 6^{PM}, and this is only 40mm less than the width of Bronze's pier opposite (see how a later master will work to a *conveniently personal* equivalent of an existing element). He made all four piers the same shape, without the enlargement at each end to take the side thrusts from the vaults, as in the north - GEOM:III-E and XV:35.

Alternatively in **i** start with a 3^{PM} square to locate the shafts, and around each shaft form a diamond and a square measuring 4 and 3^{PM}. They locate the outline of the plinth and the five visible sides of the 'octagon' around each corner, drawn thicker. The four 'octagons' can produce the whole pier as in **j** except for the recess F. Just as the 'octagons' derive from the corner shafts, so the face F will be seen to derive from the core of the pier, discussed later.

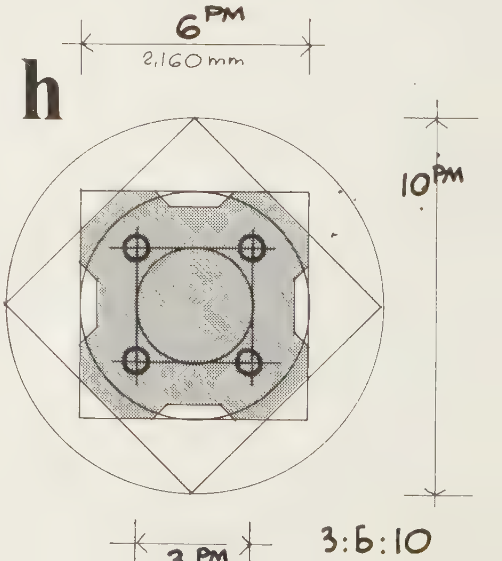
Incidentally in **k**, the thickness of the lintel forms a 2:3 rectangle to its span, and a 4:5 ratio with its base square F (1,472:1,840mm). When Rose came to carve the lintels themselves he continued the impost moulding from the S.c door along its edge, in **l** thereby widening it from Scarlet's 5^{RF} to his 5^{CF} - incorporating something inherited with something personal.

Thirdly the geometry of the plan may have been evolved from a cluster of four triangles **m**, from which he would have been able to locate all four squares (the two encasing the 'octagons', the dashed square F, and the inner one locating the centres of the corner shafts), all integrated in a very beautiful way.

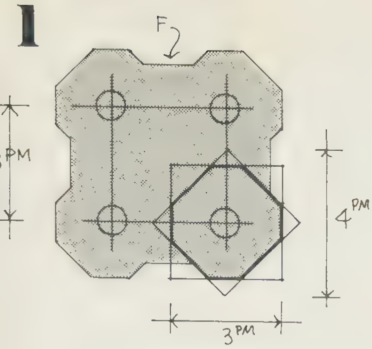
The 5^{RF} of the lintel relates through Scarlet's usual 5:6 ratio to the 6^{PM} base width in **h**. This width is expressed in the pier itself in the thin colonnettes on each side of the corner shafts. Not only are these colonnettes 5^{RF} apart, but they also lie on the circle in **n** which inscribes the F square. Everything relates to everything else. He has now created all the essential features of the plinth level, and the columns above it.

In the elevation **q** the pier is set in above the plinth by reducing all the dimensions in **i** by one ninth. There is a projection above this recess, the centre of which is 3^{PM} from the

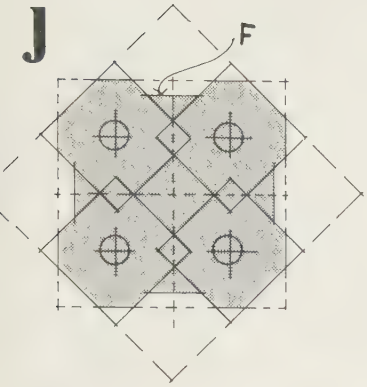
h



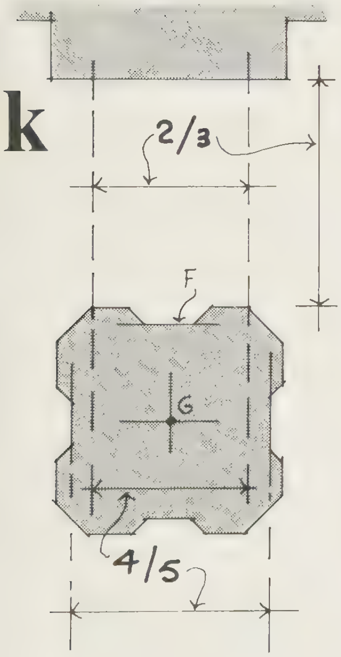
i



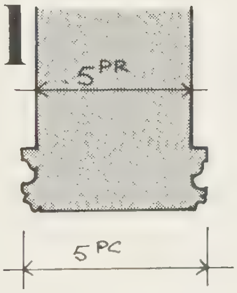
j



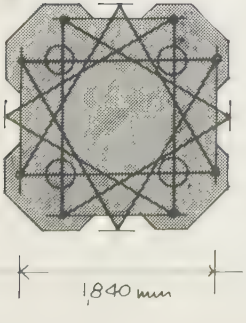
k



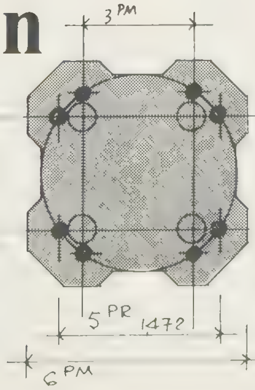
l



m



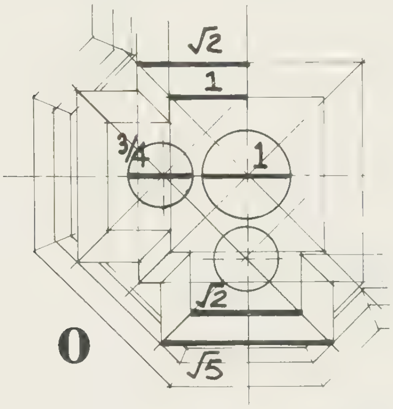
n



average paving height. This forms a cube with the inner square, which positioned the corner shafts. The bases for these shafts break through the base above this cube, and are exposed independently of the shaft. I think this was meant to show that the colonnettes were essentially decorative, and faded out of 'functional' view where the shafts met the base. This concept in which the overlapping function of different bases were kept distinct from one another, interpenetrating, seems to have been a new one, and was to have an enormous popularity in later Gothic architecture.

The geometry of the bases seems to derive from a set of modules based on the Roman palm in **o**.

In **f** you can see that behind the columns and the sculptured panels there is a core of Berchere limestone which takes the real loads of the lintel. The core is 3^{RF} wide with chamfered corners **p**, reflecting the structure in **j** and the lintels in **k**, but reduced by Scarlet's usual 5:6 ratio with the 6 being taken from the length that had been 5 in **n**. A typical move found in the north porch buttresses in GEOM:XV-A.

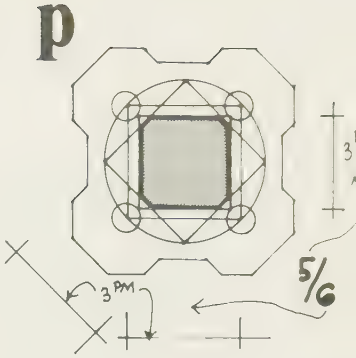


o

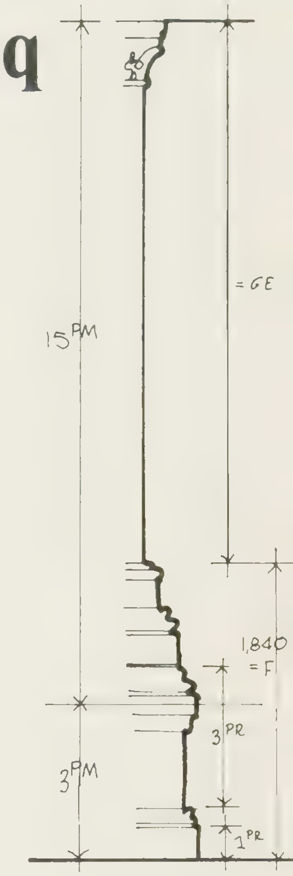
Vertically **q** he built at least up to the underside of the torus course in modules of the RF and the PM. From the top of the 3^{PM} cube, acting like an elevated footing, the height to the lintel is 15^{PM}. The overall height of 18^{PM} is 3 times the 6^{PM} base and six times the 3^{PM} width of the square through the shafts. Simple proportions in each case. The height to the top of the torus is the same as the F square, so the plinth under the core forms another cube supporting the delicate mouldings above. In **r** it is also 4:9 ($=2^2:3^2$) the distance EG in **g**, and the column height (if the cap had been built as 1^{RF}) would have been exactly equal to EG. Lastly the height of 20^{RF} shown on the left forms a $\sqrt{2}$ rectangle with the centres, and this height relates to the numbers used in the widths of the core and the base in the same way as the numbers used in calculating the 'angle of repose' alongside the transept tunnels - VI:61.

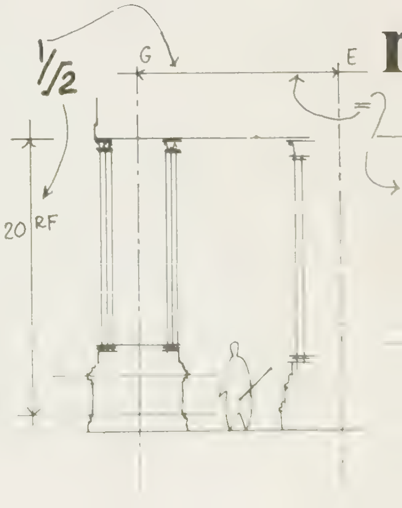
I think it is important to recognise how the best medieval geometry grows by utilising the disparities between number ratios and the irrationals that come from squares and triangles. Rotating squares are not used on their own. The result would be too simple. Squares come from numbers which are again turned into squares. Rotation mixes with modules. Confusion is overcome by relating a later step to one of the earlier ones.

p



q





drapery will be under a Moon head who will himself have had heads carved by many associates who are similar to him in many ways, yet distinguishably different.

The figure of Christ in the S.c trumeau is typical of the first gang, Stretcher. They did not do a great deal of work, but each piece is handled with a complete mastery of the material. His figures are over-solid, with the cloth drawn taut and stretched like rubber over one leg showing the outline of calf and thigh. The lines of the fabric are only lightly emphasised over the leg, and over the chest. The heads are well-modelled, ears flat with a central lobe, while the hair tends to curl symmetrically at the ends. He did not cut deeply into his material, but arranged it thinly around the figure. Folds tend to be more naturalistic than in any of the others.

The heads of the 3M gang have a child-like simplicity, and with few exceptions tend to be monotonous. They are round in form, generally unaccented with blown-out cheeks. The head sits into the neck so it appears to be supported on a fleshy cup. The three most easily distinguished carvers I have called Moon in the S.c Judgement tympanum, Mary in the N.e wall figures and Mumps in the S.c lintel where nearly every head is so swollen into the neck that it seems diseased.

Mary's clothing is quite deeply and heavily cut, with long round loops of cloth that have an old-fashioned Romanesque quality. I include the Christ in Judgement in this group, even though the head is that of Stretcher's Christ in the trumeau underneath. In spite of the superficial similarities its details were handled quite differently to the trumeau. Clearly the carvers had had instructions to match the two heads, and one of Stretcher's men may have worked with the 3M gang on this stone.

The Crown gang in the opposite N.c tympanum carved long narrow heads with sagging moustaches which cover the ends of the mouth and give the face a rather despondant air. The hair is long and flowing, only slightly accented. The ears are completely hidden, not half-hidden as with Stretcher, or just showing as in 3M, but completely concealed. He drapes more cloth round his figures than any other using the whole bolt uncut, often with a wide band around the waist. The real body does not show through.

Crown's cloth is softer and more delicate than the others, criss-crossed over the body in a multitude of folds which cover every inch of the surface. Every part is crimped, folded, and turned in or over. Yet compared to the gangs in some of the other crews there are many similarities between these three: they treat their material decoratively, working I would think from drawings rather than from clay or real cloth. The edges of the material undulates softly from shoulder to hem like the early morning smoke from a chimney. Along the bottom

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BRONZE-H, 1201.

1. The patterns on these figures are particularly complex, and quite clearly provide the links between S.wL1, 2 and 3 and R1, and also with N.w-w2, of Potentin. There is one superlatively carved repetitive pattern of diamonds, in which each face forms a sloping facet whose edges are lightly grooved. This can be best seen on the sleeve of S.wL1 and 3. This sort of patterning is extremely hard to do well (as can be seen on S.wR2), for it requires endless patience. The edges are either flattened or slightly grooved, each corner is precise without any wavyness. The whole effect of richness comes from the repetitive precision of its cutting. They are not unlike the ones he used in the north porch piers - III:39 - with the same diversity, care and axially arranged organic forms.

The stiff bodies, remote faces, polished drapery without much definition in the folds, good ears and so on, place all these figures in a group. I put two of them into campaign 'E' for convenience. Bronze could have carved them in any program.

The leaves on the crocket under L1 are not unlike *Dot's* or *Pruner's,* with two leaves resting over three, all drilled. The little figure under L3 has Elevation's clothing. L1's facial structure is not unlike S.wL4, just as R1 has the beard, eye, and scooped cloth of S.wR4. Though I have located the latter with this crew with some certainty, I am unsure about the former - see '3'.

2. R2 has many aspects of Ruby, being similar to R3 in many ways - low ears, the hair, facial form and loose hands. But the book is definitely not in the Ruby repertoire, nor are the patterns, nor the softer emotions present in the face.

The drilled pattern at the hem, with its 4x3 lobed leaf is like Potentin and the Bronze Elevation gang in **O**18. The leaf and the bird on the end of his crook is Bronze-*Lobelia.* But the lion under him, with the snub nose, is like the heraldic saucer-eared creatures on either side of the S.c trumeau, though not as well cut. I prefer Bronze, but the figure may have been begun by Ruby including most of the head, leaving the final work on the cloth and details to Bronze.

3. In many respects this is like its neighbours, though not in posture or clothes, which are restrained, with a flattish surface effect. The *fluer-de-lis* may link him with Bronze in S.wR1. He has the sharp-pointed chin of N.c-e3 by Cobalt in **N**3, and careful leaves like *Helmet's* or *Pruner's.*

The clothes are like S.wR2 in **E**, as are parts of the head, though I can also see links with Cobalt in **J**. The problems are solved if Scarlet carved it, See **E**1.

4. It is like N.wR3 in **O**6, the high line of the eyebrow, the thick mop of hair rolled at the edges (though not as well finished), the closely observed neck, and no ears. The cloth follows the line of the body, not being allowed to swing freely. The scooped folds are not unlike Modeste, and though not as fine, both statues are by men who understood one another. The boss on the shield is by *Bustle,* a Bronze gang.

See also the scoops, hands and feet in N.c-w2 in **O**16. The lines in the hair with the ends bent back into each knob are like S.wL2 in **F**4.

5. S.wL γ1 has the same pattern on the sleeve, same eyes, ear, cloth and chin as S.wL3.

6. Left β1 and ε1 both have flattened folds like S.e upper tympanum and S.w lintel - **E**3 and **H**12. Billowing ends of cloth also found in S.wR β2. I have placed them in this campaign because they have the same way of bringing the arm out of the sleeve, and for deeply cutting the edge to show how thin the cloth is. See also N.cL5 and R5 in **O**2, 3, also S.wL β2.

7. The top stone has a half crocket with a stylised leaf encasing a berry by *Lobelia* or *Horn.* The other side is missing because all the α were cut down when the curve of the arch was altered, and was therefore carved before the Christ in the tympanum - **G**7.

8. The canopy over the S.c trumeau has a Bronze corbel on the inside. The angels are the same as in '9', and the leaves are *Brancher's.* Angels are clothed in Elevation's tunics. This stone has been one of the most useful linkages between leaves, cloth, face, canopy city and the crew.

9. The keystones were carved last as infils to suit the actual conditions of the work during erection. The canopies are Bronze, the heads like '8', and the crockets by *Spring* and drilled leaves by *Odrill* - see XI:10/x.

10. This statue is made of two stones, with the joint placed just below the ankle. Bottom half could be by another master, but it is a very Modeste-like figure - the feeling for free-flowing windy cloth. Note her knot - it is splendid. See also S.eOUT, R1 by Bronze - **L**1.

However, the feet under both adjoining statues and in L2 rest on an inclined platform, while in the 'addition' they lie flat. Was the height of the figure adjusted in erection by removing an older base figure, and replacing it with a smaller one? What adjustments might have been made to other figures during erection? S.cL3, and 6, S.wR1, 2 and S.eL3 were all made too short and had to be extended. Does this explain anything about their history, or rather the heights intended by various masters before the level of the impost had been reached? Note in later statues in the north carved after the impost level had been determined that none of the statues were too short.

11. The kneeling figure under the tomb is like N.wR β2, as well as being like the friends of Job in the N.w tympanum, and Job's wife, like Judith in N.wR2 and slightly kin to Modeste. The cloth flows, and is of thin muslin. The sleeping men are like the N.e tympanum magi. The bishop on the tomb has been given the same pattern as in '1'. See also the *Jubé* nativity - n.40.

12. Flattened folds and sharp edges as in '6'. There is a nervous feeling in the clouds and gestures like S.eL β2. Stance and cloth may also be linked. with S.eL γ2. there is the same jagged cloth in the upper parts of α.

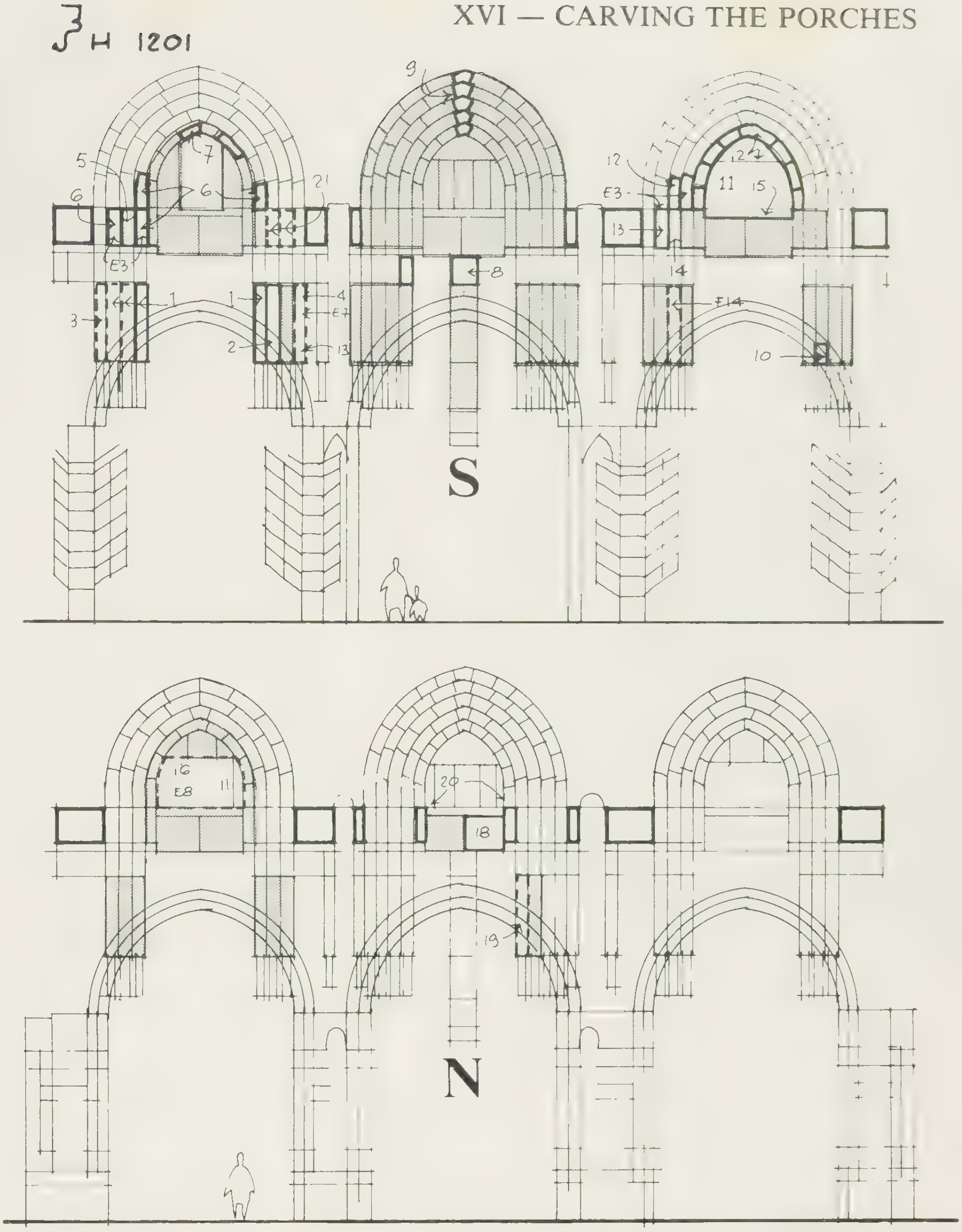
13. Naked bodies are usually carved as lumps. They are only treated with care and observed reality in two cases: S.eL δ1 and under S.wR4. Note the appearance of the bone and muscle structure under the clothes.

14. Note that the L γ1 was not carved in this campaign. Was '13' meant for here and misplaced?

15. A number of canopies have a large arch which is decorated underneath with a row of vertical planks which I have called Portcullis. With them in the nearby towers are carved double windows surmounted by an arch, Venetian style (CANS: S.wL3, S.cL1, N.w-eE2 and over the S.e lintel. The same window appears over the N.c-e4 tabernacle - n.12).

The latter shows that Portcullis is a Bronze master, and they certainly suit his campaigns. Further the arrangement of a double lancet contained within a single arch is a device introduced into Chartres by Bronze-H in the sanctuary aisles - X:42 and n.12/**v**.

16. N.e tympanum: three of the heads appear Moonish, but all the rest is Bronze, as in the heavy folds also on Lγ3 - **F**19 & **L**10.



18. Lintel carved by the Elevation gang - figures closely packed, clothing of heavy waved folds, and with carefully arranged sinuous hands. He handles drapery as if was of woven gold. Note the stylised lobed pattern on the edge of the tomb by *Horn*, and the diamonds on a number of the sleeves, as in '1'. Often put the ends of the hair into randomly placed curlers.

The cloth bunches over and hides the belt with a characteristic twist at the ends of the folds, which is a standard characteristic of this gang: see particularly N.cL6, R6, N.c-w1, 2 in **L**12 and **O**16.

The figure on the right has the cloth folds, the stance, and the hand holding his clothing just like the magnificent support figure under N.cR6. The upper right end of the stone was replaced, as if the rounded corner I would have expected from him had been replaced with a square one to suit Cobalt's later canopy - **J**9.

19. See **F**21. However N.cR1 has the folds and waist of N.cR6, and his beard, and it has the small pointed chin of the N.c lintel Virgins. The willowy figure suggests Bronze, but there are links in the hair to Scarlet, and in cloth to Cobalt. Confusing. However the support figure of Jesse has the cloth of Elevation, the head and cheeks of Bronze in N.cR6. Could it be a Ruby-Scarlet(?)-Bronze combination?

20. α1 clearly with the nearby lintel. I am less certain about the upper ones.

21. The hair, double grooved outer ear, and surface chiselling and nostrils may be like S.wR3? This may just be the Bronze influence in this one, for it also has the waist of N.c-w1; so I prefer Bronze to Ruby.

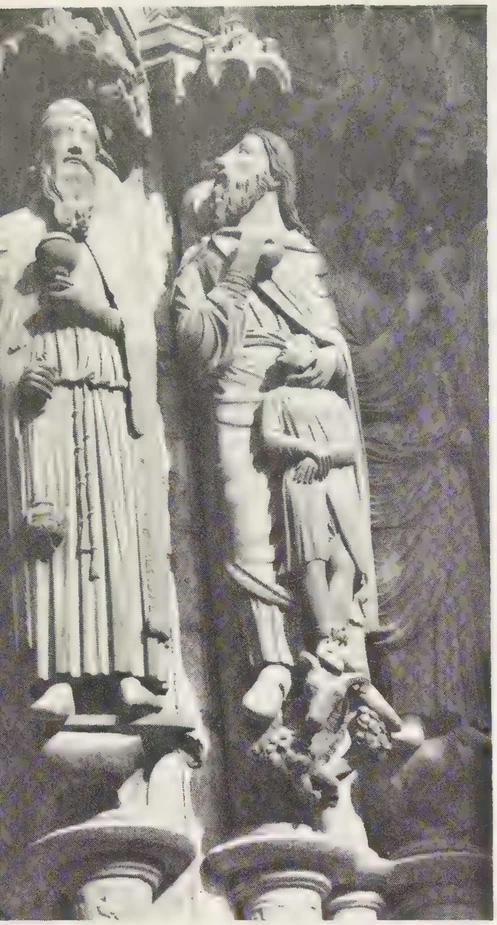
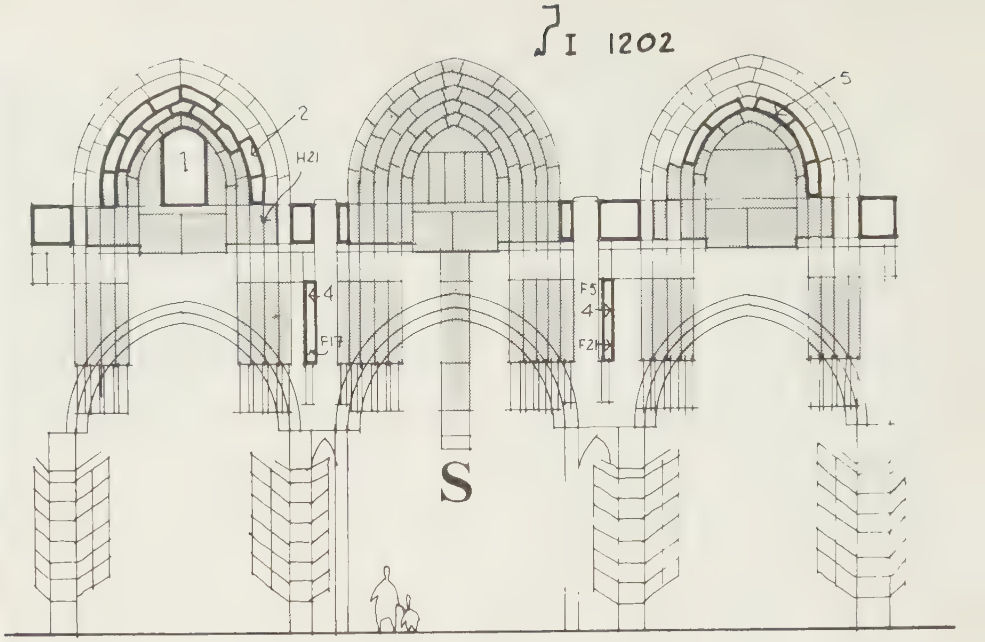
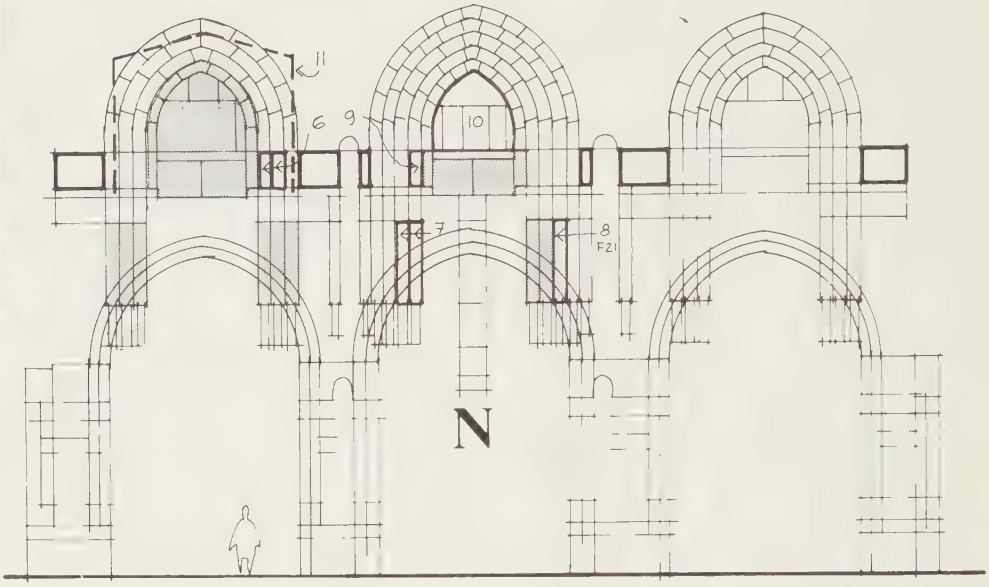


PHOTO 382: Melchizedek, Abraham and Moses from the N.cL embrasure. Both Abraham and Moses have Forker's deeply incised drapery - one of Ruby's gangs, and probably carved in 1206. Melchizedek on the left is by Bronze in the year before.





RUBY-I, 1202

1. See **G**6. The folds are Crowns, swathed, as in N.c tympanum.

2. These archivaults were carved in groups of three. The cloth, out-thrust kneecap, and faces are of Ruby gangs. Responsibility seems to have been divided among the gangs by giving them each a group of contiguous stones.

4. See text. The cloth in the S.c trumeau is similar, as is N.eR2, if a little more aware of the body. He does not expose his limbs, but swathes them in a coccoon. The leaves under the left one are by *Frills,* and under the right by *Braid.*

5. All four figures have the plain faces, hidden ears and wavy hair of Ruby. Some connections with S.c arches, but I prefer to link the diamond pattern in the hem with the similar decorations on the panels of the north porch piers by Ruby.

6. N.eR β1, γ1 like the Visitation.

7. Hair, hands and folds of Forker. In spite of the apparent thinness of David, this pair, and the next - **M**4 - are clearly from the one shop. The nose is long and pointed, with a triangular cut between the eyes which are small and flat. The forehead is grooved, with a deep set crease across the bridge of the nose, double ridged eyebrows, moustache and upper lip. The sides of the cheeks are flattened. Together they show these four heads are from the one source.

But especially look at the clothing, **M**4.

There was a theory that David was an earlier figure because it seems too thin. This theory will not wash, for when measured it is no thinner than N.eR2, S.cL1 or S.wL1. It all depends on where you measure it - and how you turn it: for if David had been turned a little, or even if he had been placed on the opposite embrasure with a big figure on the other side of him, the slenderness would not show. More depends on placement than is realised.

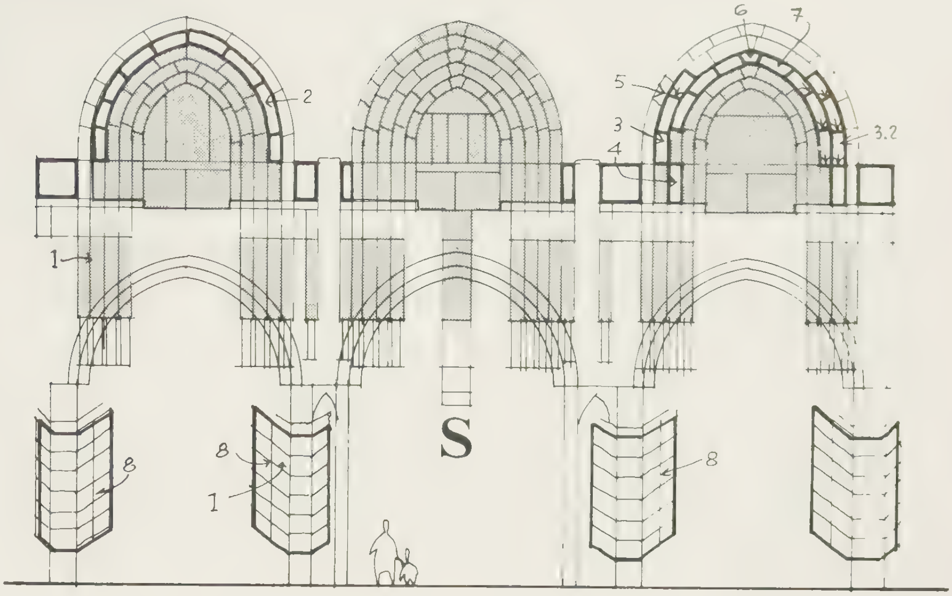
8. Stretcher-Forker type. The leaf under the crocket has the same stylised form as the leaves of the Tree of Jesse in N.cL δ1 by *Hide.*

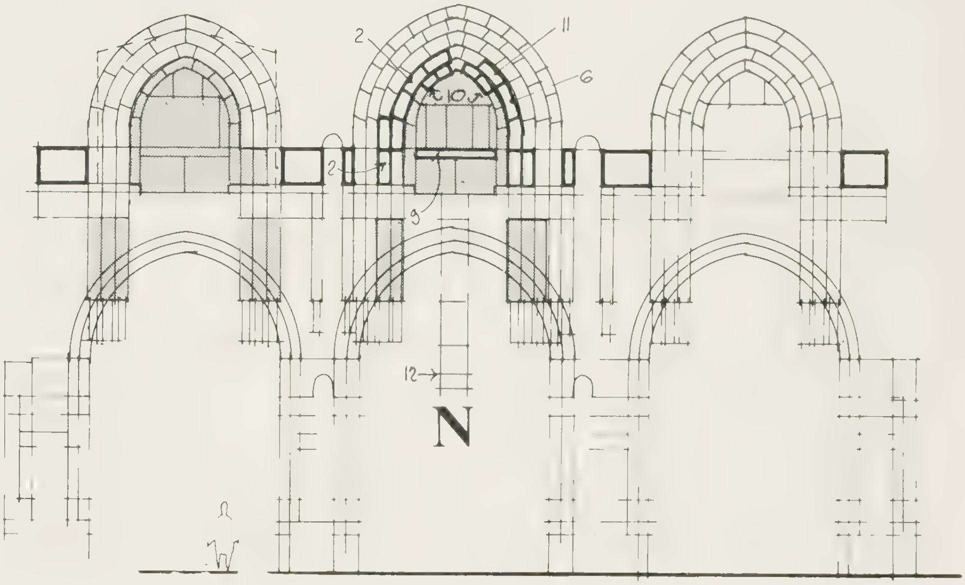
9. The split beard etc of Stretcher.

10. Figures, angels and clothes discussed in text. Note peeping foot. The upper stone has the simple canopy Ruby preferred - n.12 - and the capitals are by *Rocky* and *Frills.*

11. The temporary 'roof' over this porch could have been built here, particularly if the next two rows of archivaults which I have shown in campaign 'L' were completed in 'H'. XI:14/1 and XV:32. More likely by Rose because of the panel on the outside - **K**13.

7J 1203





COBALT-J, 1203

1. The S.wL4 figure could be by Cobalt though it is not unlike its neighbours. But it is also like N.c-e3, and parts of the face remind me of N.wL2, while the clothing is similar to N.c-e4. The devil under the feet is like S.w-eW5 panel by Cobalt. A problem, see **H**1.

2. R δ2, 3 are not unlike S.eR δ2 in form and posture. Others are like N.cL Υ1 in the long smooth nose, the turn of the body. Others resemble the upper N.cL Υ.

3. The seated figures S.eL δ2 and R δ2 are like Solomon in the N.w lintel in **N**3. Later figures tend to have cloth of muslin rather than soft wool.

4. The S.eL δ1 horseman has the head, uprightness of figure and squareness of N.wL1.

5. As in some of the panel figures, and the uneven hemline as in his north tabernacles -**N**9.

6. Most of the archivault figures sit on pedestals which form canopies over the ones below. Cobalt carved webbing under them, while some have rosettes set in the centre -n.12. This includes the S.e keystones. See N.c β.

7. The S.e archivault heads are pushed into their canopies, the haloes are often cut too, so they must have been carved for one height and reduced on installation for a smaller one. The curves on their sides precluded them from having been cut for any other arch but the one they are in. They could have been intended for the S.w door, or the impost height may have been raised in relation to the tympanum and lintel.

The latter seems more likely when you examine the way the impost butts into some of the lintels. Perhaps Cobalt did not intend to build imposts, or perhaps he intended to set the bottom of his arch figures straight on top of the canopies. Though I am not satisfied with this 'explanation', the cutting remains. See GEOM:XVI-B.

8. Cobalt carved all the south pier panels, which have been split into the gangs, and in some cases individual masters, in XI:10. The S.e-wS5 of Luxury is equal to N.wL2, the bearded kings are not unlike the N.w lintel, others match N.eIN,L,top and etc, etc. Connections are too numerous to list. The clothes have swaying and uneven bottom edges, and a few have peeping feet.

The leaves which surround the panels are vines etc as in the caps - XI:19 and n.12 - and the small capitals within the panels themselves reproduce nearly every one of the leaf forms used in the internal capitals, especially those of *Helmet, Stitch, Gobble* and *Multi*. The capping stones include cities and leaves, and though some have been replaced, they are meticulous if somewhat heavy copies of the original. This can be seen from the originals still in the WS tower.

Behind the panels the vaults are supported on octagonal limestone piers which take all the load from the lintels. The carved panels could have been erected after them, but not after the lintels, for the caps which finish off the top of the panels are made from two stones which pass across the pier, and the lintels rest on them. See Branner, 1960(2).

9. The canopy over the N.c lintel is exactly cut, with drilled 3-foil openings like his in the south panels. Obviously he is beginning the process of setting out this door along with the surrounding archivaults, as can be seen in the internal elevation X:48.

10. Many Cobalt characteristics in upper α.

11. Similar to S.e, sitting on seats deeply drilled like their canopies, and with webbing under them, some with rosettes. N.cL β 3-5 are like N.wL2. There are pinched folds over the belt and under the armpits. Squared facial structure.

12. The bottom course of the N.c trumeau was laid before Cobalt, n.1 but his column base is 1^{SF} high and has a typical groove under the torus. However there is a leaf in the plinth stone either like his out of the WN(t) door -XII:4 - or like Ruby's out of the upper ES 'door' - X:23. I prefer the latter.

hem of their male figures the cloth is nearly always cut level, as with a knife, so the feet seem to have been just added on.

3M's material is denser than Crown's, and has difficulty in bending at the ends. It lies stiffly at the feet, falling in thick edged round loops. The folds are bulky and the indents between them are cut quite deeply, though not to the same extreme depth as in the last gang, Forker.

Forker's most common characteristic is to form thick folds of cloth which project, and as each widens at the end of the fold, to scoop out the centre to form a flattish area that looks rather like a two-pronged fork. This device is usually found round the sleeve, or in the denser gathered material under the arms or over the waist. In the two extreme examples of Moses and Abraham, N.cL3 & 4, the forks are so numerous and the scoops so deep that all feeling for the natural cloth has disappeared. There is instead a magnificent tactile quality not unlike stiff dough.

Forker's heads are the most individualised in this crew: some have stylised curly hair, some have massive heads set on necks thicker than their foreheads, and some with delicate fluttering beards. Yet they all wear the same deeply gouged cloth, which seems to become more and more stylised with time - for after putting the figures into an architecturally acceptable order the simplest of these folds are found in some of the apostles, the more complex among the outer figures in the N.e embrasure, and the last and most complex, perhaps dating from 1206, are the two patriarchs in the N.c door, Moses and Abraham.

Forker's work is seldom found in the smaller figures of the archivaults, yet the viscous strength of his from sets him apart as an extraordinary creator. Perhaps he was the master of the crew, Ruby himself, unable or unwilling to devote time to minor works. The strength of his personality impelled many of his men to imitate him, and all of these I have included in the Forker gang, including the carvers of the eclectic figures of Thomas and Piat - S.cL3 and S.wR3.

Forker seems to have carved a few figures in Mump's S.c lintel, and someone carved a Forkish beard on a typical Mumpish face in the N.e lintel. They seem to have helped other gangs in odd jobs, including a few of the little figures hanging under the wall statues. It is mainly through these interconnections that I have grouped these different men together into the one crew. My detailed reasons are set out in the drawings and notes spread over pages 374 and 389.

It is a sign of the freedom within the crew that in spite of Forker's technical proficiency, none of his idosyncracies are to be found in other gangs, just as none of Mump's are to be found in Stretcher's, nor Crown's in Forker's. A gang seems to act in a completely independent style, and for this reason the artistic direction of the different doors was apportioned among them. The S.c doorway seems to have been directed by Stretcher and 3M, while the north was given to Crown and Forker. This policy imposed a certain amount of stylistic unity over the two doorways. Yet a common flavour seems to run through them all, seasoning the attitudes and conceptual processes of each sculptor. They all, in their own way, tend to subordinate the reality of their figures and to reduce their humanity within a stylised garb. Limited to preconceptions, nearly every work lacks the depth and profundity of Bronze's or Cobalt's best work, and with the exception of the stylised energy in Forker they lack life too. Their stylisation is so paramount that the type predominates over whatever we coud have known or inferred about them. Even Peter and Paul in the S.c are abstractions, while the faces of Mary, John and their attendant angels in the tympanum above could have been cast from the one mould. Characterisation is achieved either by superficial additions onto a stock face as with Elizabeth, or by over-emphasis as in Abraham - N.eR2 and N.cL4.

I do not wish to denigrate Ruby's work, for there is much greatness in it, and he was after all chosen above all others to carve some of the most important work in the cathedral. His technical ability is superb, he places his figures with a tender regard for one another as in the Visitation or in the four apostles on the left of the S.c. When studied in depth his clothing patterns are a delight, if only as playful arrangements in their own right. Nevertheless, in trying to define the spirit of the crew as a whole it is hard to speak as positively as I can for the others.

By comparison look at the sensitive multi-layered depth psychology of Bronze's friends of Job, N.w

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ROSE-K, 1204.

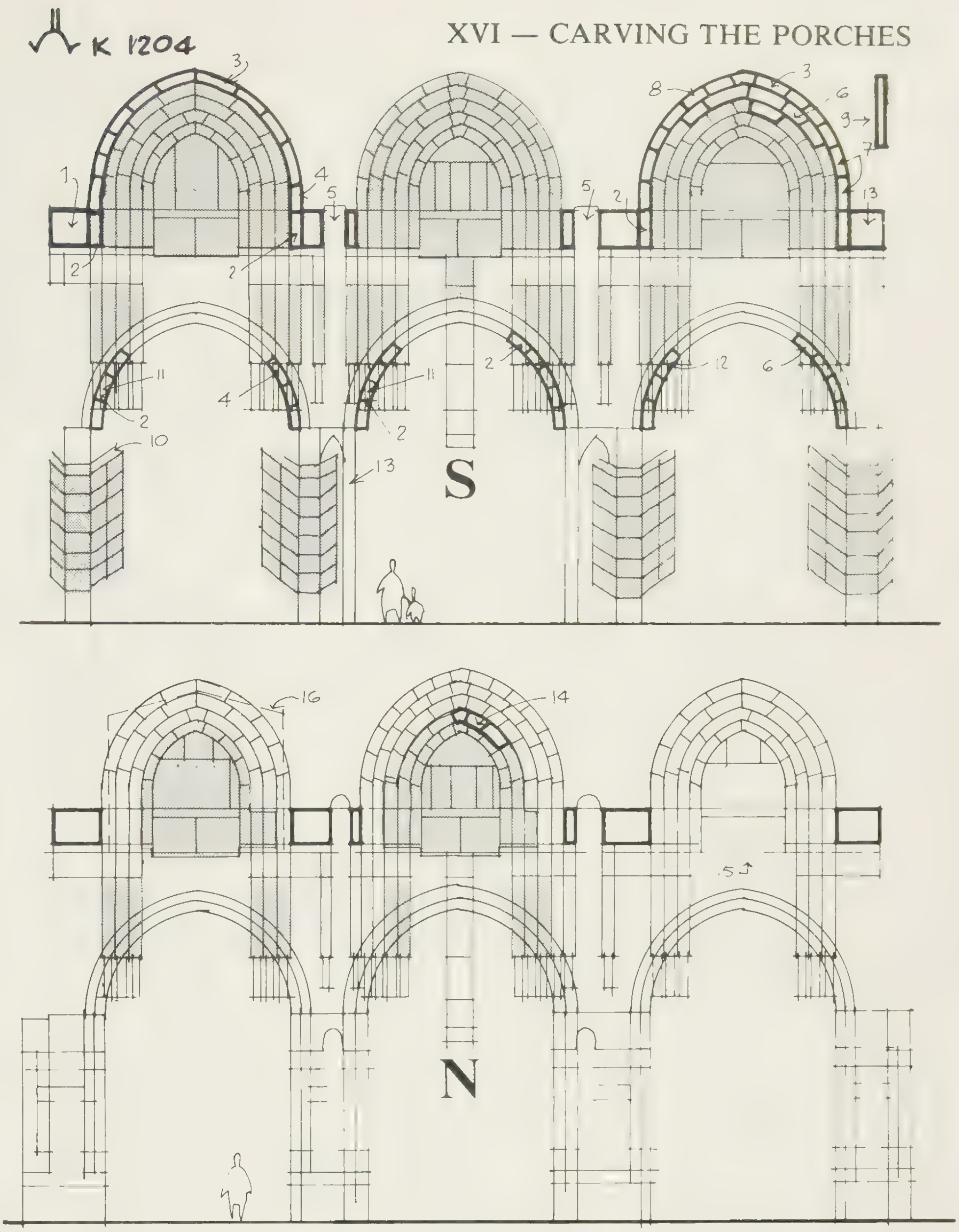
1. Under the rib supports of the south lintels there are leaves by *Bird, Cotton, Goose* and *Cup*. In the narrow panels which decorate each side there are similar leaves - X:56/g.

2. Cloth and figures of S.cIN,L2 and R5, S.wIN,L2.

3. Carved all the ε arches with the lintels.

Same facial types in both, and some have the same cross-like structure to the face as S.wR4 with clearly modelled neck and stylised almost Assyrian face. The beards are of lightly chiselled layers like S.wL4. Is this therefore sympathy? or could these two saints have been carved by Rose? He has not carved here before, but later there are many similar figures under the N.c vaults with round faces and square figures, see his area in n.38/U.

Rose's figures are firm, solid and squat, so he tends to use smaller stones than the others with more figures per arch. This was his first arch, and the porches may have looked quite different if he had played a bigger part. The arches are cut from very good quality hard stone, which shows none of the signs of weathering so common elsewhere. The wear not only comes from wind and frost, but also from the action of damp on porous stone, and it is those which have been set on an angle in the arches which have weathered, rather than those set upright on their bedding. Better quality stone hardens after a time, as in the



wall figures which have suffered little over the centuries.

If we knew where each stone came from, and could then link that stone with a crew, we may then know something of the master's hometown, for we can probably presume that most of them worked in quarries before they wandered. They would tend to prefer their own stone in their carving.

The ε archivaults have leaves carved along one edge. They were studied by Pat Keiller. In the S.w they form a pattern all round the vault of a pair growing from either side of the stem, followed by another pair and a third growing out over the stem, then a pair again, and lastly two and a berry in the middle. It then repeats with a pair, a three, a berry, a pair, three, pair, berry, pair ..... There are slight differences in the way the leaves are handled - some being drilled, others deeply cut, or triple berries or singles and so on. The triple berry is only found among Rose's men, never with Cobalt or the others. It is in some of the south pier caps, showing who did the lintels.

The S.e pattern is more pendulous, with more stylised leaves. A lobed leaf hangs over, and suspends within itself a berry rather like a Victorian gaslamp. The slight variation in depth of cutting, curve of leaf etc are the only signs of different hands. There is strong control in this gang. Though many men carved statues on both sides the leaves are consistent. Rose is a unifying master.

4. Drapery falls in 'Y' folds between the legs, like S.wIN,R3.

5. Built the SW.31 window, and began SE.42.

6. Like S.eIN,R3 and 5, with many Rose features, though?

7. This is the carver with the classical drapery, like some by Cobalt in N.eIN,R5-6. If this is Cobalt, then he began the ε which upsets too many other attributions. What is the possibility that Rose carved the northern figures - n.38/S2.

8. The upper ones form a compact group, with one in the S.w of bishops whose albs fall over their knees straight, as if made of wood without bending into the body. Heads thrust forward.

9. The king over the porch probably by Rose who set the pattern for simple non-individualised types. The others are Bronze - III:23 and adjoining photo.

10. *Cotton* capitals like S.eL4, and triple berries in '3'.

11. S.cIN,L2 like S.wIN,L2.

12. S.eL4 must have been set up with the other statues before the lintels, yet there is no ring moulding under the statue to attach the bottom to the wall, but instead it rests directly on its solomonic column. This column is a simple one, more simply cut than any other in the embrasures, and it is longer. All the others are 1,100mm long while this one is 1,310mm. Had it been left over from another job nearby, or even from as far away as Laon whose columns - replaced and modernised in the nineteenth century - are almost the same length at 1,295mm.

There are all the marks of a snap decision: Rose had carved and was setting up the lintels. The time had come to install the last wall figures in this door. But when they looked for the solomonic to go under him they could not find it. Panic. The scaffolding was ready, the need was urgent. Could they wait a week while another one was cut? It seems not.

13. The lintels alongside the side doors are supported on four large and stable piers, but the central ones rest on very slender columns, so that lintel and support had to be put up together - X:56.

14. The two upper figures are not unlike the S.IN figures. The canopy over the keystone of the N.c β arch has the same repetitive regular windows to be found over the S.eL4 canopy.

15. The N.c and N.e tympani can now be erected if we take the date of the outside panels adjoining the canopies as their determinant - XI:14. If the corbel under the N.e lintel is Rose - n.12/33 - then this is certainly true; but if it is Ruby the date can be moved back a couple of years - I11. All the problems that were to be found in the NW stairs discussed in chapter XV stem from the fact that at this date no sculpture had been prepared for the remaining N.w door, nor was any to be started until 1207.

16. The temporary wall and 'roof' discussed in I11 would certainly have been built by now. No more work was done to this doorway until 1208, and the 'roof' was not finally absorbed into the upper work until 1214.

tympanum, or Cobalt's Sheba in the same door. The warm body of Ruby's figures is always hidden under clothing which is more concerned with its own substance than with the flesh it covers. They are enfolded within a casket of cloth, and only rarely do you glimpse any of the muscled flesh underneath. He even stylises the hair, being almost the only master to add forelocks over the foreheads of his male figures. Even the goat under Abraham has the centre of its head set in curlers. Occasionally you find it in other men's work, perhaps in sympathy with Ruby's, but its rarity elsewhere shows up the special place it held among Ruby's men.

Could these four gangs have carved all this work in their three campaigns on the site? Remember we are dealing with really large masses of men, perhaps up to 300 in each workforce of whom about 100 formed the skilled core of the team.[23] From these come the gangs, some of whom are simply cutting at the quarry, some erecting, some doing repetitive work, while only a few were delegated to the most exacting tasks.

I made some rather rough and ready calculations of the number of skilled men needed in a team to do all the carved and sculptured work in the building. Studying one of the larger campaigns, that of Bronze-L in 1205, I found that his men carved 7 major figures and another 85 in archivaults and on the tympani, as well as over 30 minor decorative heads around the nave windows. They also made 36 panels for the north porch piers, some 40 canopies and over 120 other important carved pieces for capitals inside the building, and 16 or 17 bosses.

Added to that, of course, they carved ribs, piers, cornices and other mouldings, doors, windows and stairs, and innumerable ashlar blocks for plain walling. Concentrating on the carved work that required the highest skills I concluded that in a year's campaign the crew would have needed only 22 men to do all the sculptural work. With their assistants this would have occupied less than half the permanent men in the crew, being the most skilled and talented. The bulk of the local

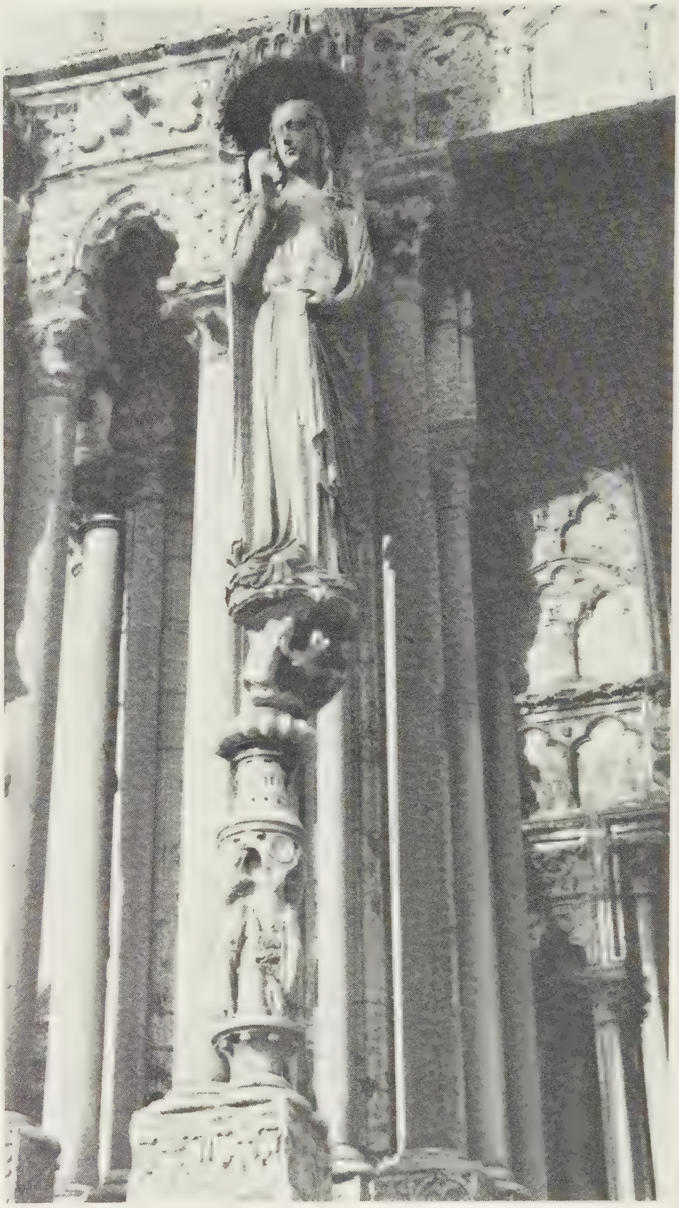


PHOTO 386: Ste. Modeste on the western side of the north porch.

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[23] I:9-10 and text.

BRONZE-L, 1205

1. The S.IN upper figures are stiffer than Rose's, with more solid if thin-edged folds, standing under jumbled canopies like the N.w-wW (given to Cobalt in n.12/1). Clothing folds in facets, by gang of S.e tympanum.

2. All the sculpture in the S.OUT arch have the fine folds of the Modeste gang. Many have one foot forward forming a triangle at the ground not unlike many of the N.c right lintel figures. Marvellous whimsicality in the outer bottom figures dressed in feathers. One in S.eL almost smiles. See Job **P**5, and canopies in XI:10.

The same group carved the N.e OUT, but a dozen years later where their work is more intricate with delicate long unbrushed tresses and many smiles. One of these figures stands on a base identical to Modeste's - n.38/X1.

3. Arches added over the face of the lintels - XX:56.

4. Vertical panels set into slots over the lintels on the front of the porch, and over the sides. They were set in after the lintels were put up, and the old photos shows that some had fallen out by 1900. All by Bronze *Pruner* with a trailing vine. They are carved from a finer stone than surrounding, and match his caps. Notice the berries, and how one spiral begins from another, and how its branch passes underneath the main stem before curling outwards. Same arrangement used by Bronze over north porch - n.38/X2.

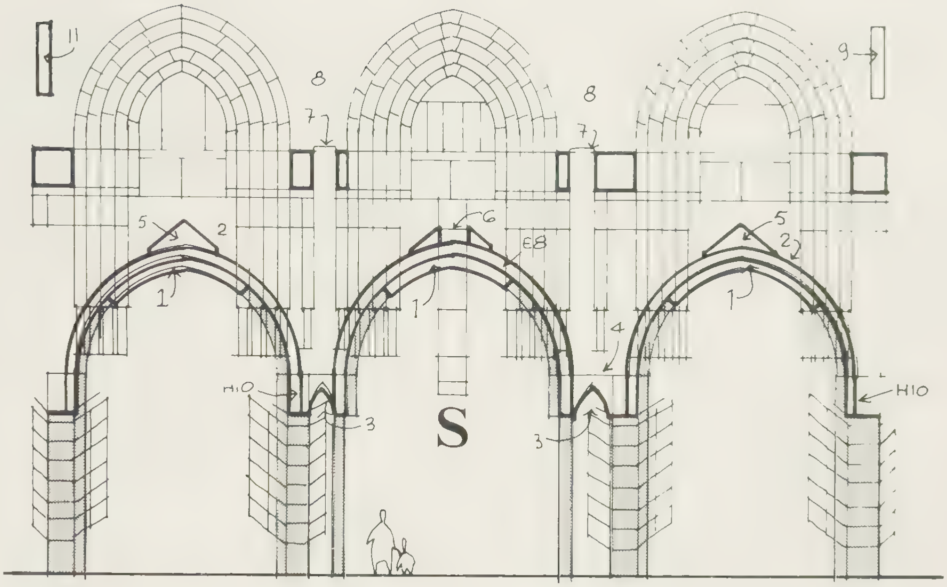
5. Gable figures also Bronze, as in wings and canopies.

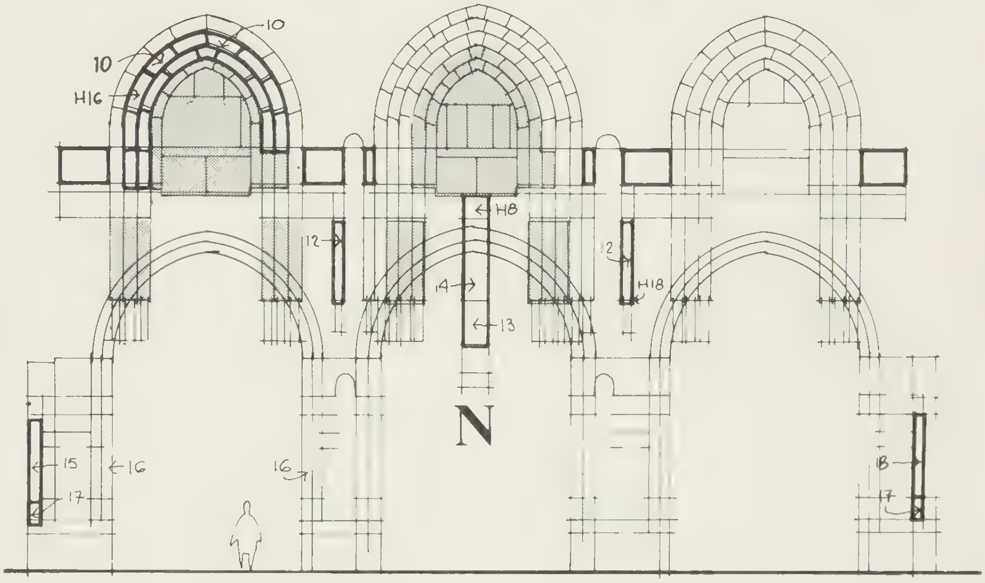
6. The joint between the central and side stones is obvious, see **M**1.

7. Covered the gap between the lintels with flat stones, for the tread 31 windows show that an arched ceiling was intended - Bronze's ceiling cuts across and obscures the window heads. He began the roof drain and the SE buttress and doorway - GEOM:III-D.

8. Lion spouts, though replaced, are not very different to the originals. They are like the ones in the north and could have been Ruby except for the *Pruner* panels which continue past them to the porch cornice. Maybe both masters used this device, but with different sculptural forms now lost in the weathering and remaking. Nevertheless I have given both to Ruby. Their cousins are to be found at Gallardon nearby. See X:56 and N.38/a1.

ʒL 1205





9. Most of the kings seem to be the work of Bronze, but given to a minor crew. Some may be Ruby. They are all to a common pattern, with similar arrangements of clothing, wavy hair as in **E**3, crowns, and plinths. One or two heads are worth studying. Notice the one figure built into the wall - **K**9 - and the western one originally carved for the north central door - **M**3.

10. N.eL ϒ3 has the folds, and heads of the N.e tympanum - **H**16. All other figures are of the Modeste type with long trailing sinuous clothes. Note hands and stance. See S.OUT in '2'. The keystone has wings with the same pointed feathers found in S.OUT.

11. The westernmost king in the S.w porch is not freestanding, but is attached to a column showing he was not intended for this position. It is David, for there is a small figure of Jesse underneath him. It is a simple statue not unlike N.c-e3, but I cannot ascribe it to Cobalt. The leaves which grow from Jesse and encircle the bottom of David's staff, are cut between their lobes in a Bronze-*Pruner* manner.

It may have been carved for the N.c door, but was not used. Did the figure the Ruby-Forker gang carve have a better iconography? Was it an improvement to place the Jesse under Isaiah and the Royal lion below David as Katzenellenbogen thinks? Or did Ruby just not like this David's effeminate gentleness, and take the opportunity offered by the porch kings to dispose of it? See III:24.

12. N.cL6 is very similar to R6 - clinging cloth, excellent hands, with the tunic hanging over the waist and little tucks which twist it sideways. Legs do not read through the folds. He assumed that their canopies would have been set to the same height as the others in the doorways. In fact they were lowered some 100mm, so that the haloes had to be scooped out to take the bottom of the capital. From the canopy the statues were installed by Ruby-M. Explained in GEOM:XVI-B.

13. All that is left of the sculpture are some scooped leaves, suggesting Bronze-*Lobelia*.

14. Anne has much in common with the lintels - face, baby's skirt, stance. Her button-like chin is often found among Bronze figures, but is also found among other masters, and may be a convention - N.c tympanum, N.c-e3, N.c-w2.

Her drapery is closer to Bronze with its wool-like cloth and deep cutting - N.c-w1 and 2, and N.w tympanum. If by Bronze it suits its supports and canopies, and the most suitable date for the erection of this doorway. See XV:31 and I:7. In XV:15 and 40 you can see that the N.c door was now being put up. There is a joint through her neck, but the head is not a replacement for the tendons and veins of the neck was carved with the body. There are similar joints in S.eR2 and N.c-e1.

15. N.e-e column figure with bent elbow and the pointed features of this team. It was carved with its tabernacles, and erected with the canopy over it in 1205 - n.38. On top of this figure's crown is a pair of leaves, lobed and stylised, holding a berry and with a tri-lobe leaf underneath - the work of *Odrill.*

16. The canopies over these missing figures are Bronze-L, erected with his lintels. Hence the statues could have been by Brone or his predecessors Rose or Cobalt. If by Bronze would the statues of the Church and Synagogue be like his similar figures in the N.e δ top in **O**1, and if so, would they have looked more like those two famous figures at Strasbourg. Note that the latest date for these figures would have been 1205.

17. Sauerlander recognised that the northern tabernacles are related to the other work I have ascribed to this team. The bottom edge of all the figures is uneven with vertical folds and the tucked waist of the Elevation gang. The cog wheel-like ring around the top of each is carved with the column and the tabernacles are set in between them and the torus, except in the eastern and western pairs which are integral with the shafts. They all have berries within their crockets, and the shafts under the N.w-e1 and N.w-w1 with their rambling vines are characteristically Bronze-*Pruner*.

18. Potentin, N.w-wW2, has the face, beard, windblown hem and drilled patterns of Bronze's S.wL figures. The support figure has a dress caught in at the waist as in the N.c lintel and the north tabernacles. The inner figure of Modeste relates to many other Bronze works, with thin muslin cloth falling well over the feet and with a meandering hem. See particularly N.e β, ϒ and S.OUT, particuarly R1, and the figure which sits on a base identical to Modeste's - '2'. See also S.eR2 in **H**10.

labour would have been absorbed into the other gangs carrying out less exacting work, particularly in carting, hoisting and laying.

This accords quite well with the impression I get from the leaves and the sculpture that Bronze had five or six separate gangs, each under its own foreman and containing a further five or six highly competent men. These figures do not vary much on other occasions, showing that the big crews were probably all organised in much the same way. If you are wondering what the best men were doing when there was no sculpture, just think of the number of capitals, the tori and bases, mouldings and jambs that were required.

There is only one exception to these figures: in the enormous amount of sculpture prepared by Ruby in 1199 for the S.c doorway. How did he handle it? Certainly it was a large campaign elsewhere, as the work on the walls of the nave show, but was it large enough for the completion of 21 major figures, as well as all the smaller but still exacting sculpture in the tympanums and archivaults?

As you can see in the drawing on page 375 he seems to have concentrated on the one door, for all the wall figures are his, the whole of the tympanum, and all the lowest archivault figures. Though he did do some work elsewhere, the bulk of his time was spent here as if he had been instructed to finish it, even at the expense of other sculpture. Some of the other carving from this campaign are of such poor quality that I think he had concentrated his best men in the S.c door, and had to make do with his second rank in the others.[24]

Perhaps a single large donation had been made for the sculpture, and had been earmarked for this door.[25] The possible presence of Louis, Count of Chartres, in the support under the trumeau, and again among the saved on the left of the S.c lintel, suggests it may have been his donation.[26] Had Louis decided that Ruby was to do this work because he had worked for him before, or because he was the local man? Or had there been a competititon for ideas in which the strength of his personality, and the concentrated logic of his concept accorded most exactly with the ideas of the Chapter?[27] The layout for the porches had already been begun by Olive in 1197, and a competition could have been held in that year.[28] Was it adjudicated in the next year while Bronze was in control, but given to Ruby who was then working somewhere else? Ruby would then have begun the sculpture in his own quarry in 1198, and would naturally have been chosen as the next master after Bronze left the job.[29]

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[24] See bases to the north porch piers, particularly N.e-e in III:39.

[25] It was not uncommon practice for donations to be made for specific parts of the building. Examples in Lepinois and Merlet, 1862.

[26] Van der Meulen, 1967, p.154, n.18.

[27] The few surviving documents suggest that the client and the architect did at times work together on iconography. In a modern example the evolution of the meaning in the design of the Sagrada Famiglia at Barcelona came from the architect Gaudi's inspiration. He is one of the few examples in our day of men working in the medieval tradition, and leading his client to a greater understanding of what the building could be.

[28] I know nothing of Olive's style of sculpture from his work on this cathedral, so it is possible he could have worked on, or begun the S.w lintel, and even the N.e.

In **E**8 I raise the possibility that the Confessors on the right hand side of the embrasure, and which are too large for the opening they sit in, must have been carved before Bronze set out the porch in 1198, for these statues imply a wider spacing between their supports. It is possible they may have been carved by Olive, or even by Scarlet himself in the very first campaign. In either case the commencement of sculpture before the doorway itself was laid out is certain, and this method of organising the work may have been used elsewhere, and may have some bearing on the way we analyse other buildings, and also the western porch at Chartres. I would like to have more work to attribute to Scarlet and to Olive before theorising further.

Besides the Confessors, there are other figures and voussoires which have been either cut down or extended in erection. In each case the explanation will be seen to stem from the changes in the crews, and the way in which the stones cut for one design will not suit the final arrangement which is determined more by the erector than anyone else. The S.w tympanum is a good example, in which the central stone was cut for a lower arch than the side ones. The latter were pared down, and so were presumably after the figure of Christ - **G**6, 7 and **H**7. The S.w lintel is shorter than the others, as is the left half of the S.e lintel - **E**3, 6. The differences are taken up in the canopy course and in the adjoining archivaults, except that in the S.w these stones are smaller than their neighbours, as is the western one in the S.e - **F**1, 13.

Other examples are the transfer of the figure of David to over the south porch in **L**11, the possible misplacement of David, Sheba and Judith in the wrong embrasures - **I**7, **N**3, **O**6, the lowering of the canopies over N.cL6 and R6 resulting in the cutting off of the tops of their haloes - **L**12, and the extensions to the columns of S.cL3 and 6, S.wR1 and 2, and S.eL3, all of which were made too short - **H**10. Study the comments on the sculpture to see how I have explained each one.

[29] The stiff tunic-clad figures of the S.w lintel, with their rather frozen gestures and separateness are somewhat like the lower figures on the N.wIN vault. Sixteen years separate them and, if you can agree with me that both are by the same man, you can see how the sculptor has developed over the years.

The northern butcher with his upraised arm and the cloth pulled taut from the crook of his elbow to the belt is just like that of the men stoning the martyr in the S.w lintel. Though in n.38 I gave these figures to the Red crew, I have no real evidence, for as with Olive there is almost no other carving by this crew in the cathedral from which I can make a comparison. If the S.w lintel was by one of Bronze's men, the order of work shows that the N.wIN could not have been laid by Bronze-X. If the S.w lintel was by Olive, then in the north he is not to be found between 1212 and 1217. If the north is Red, then the south lintel is not his as he did not work on the cathedral before 1213. Either way, the two parts may be different men, or the mason moved to another team.

The explanation I like best is that he was a pupil of Bronze's Elevation master, for there seem to be links between him and the right half of the N.c lintel (clothes, stance, but without his teacher's close organisation and liquid sense of cloth), in which case he was trained with Bronze, and after his journeying teamed up with Red, or even with Rose, Scarlet or Ruby - n.38.

[30] The absence of Bronze's carvers in this campaign may be the result of a sculptor's competition being held, during which time all work on sculpture was suspended. If the competition was only for the S.c door, Bronze may have begun work on the others. If all sculpture was stopped until the competition had been decided, the Chapter may then have authorised Bronze to continue with parts not covered in Ruby's contract, and as this may have happened towards the end of Bronze's campaign he may not have had time to do much. Was he disappointed? for he had planned the door layout.

[31] It is generally considered that the stone for the sculpture came from the Senlis, St-Leu-d'Esserent locality (Mallion, 1964, p.101 and Simson, 1964, p.218 for example). Jean Lauraunt (see VI:1) has shown me samples of stone he collected from the quarry of St. Maximum in that area which he thinks is identical to some of the stone used in the Royal Portal figures.

There is something curious about Bronze's work at this time. In all later campaigns we find two of his most skilled gangs working on the sculpture: the Modeste gang I mentioned earlier, and another, the Elevation gang, who produced the right hand side of the N.c lintel with its soft drapery set into almost musical rhythms which was gathered into the long-fingered hands of his figures. They are often clad in tunics with a characteristic sideways tuck at the belt as in Isaiah - N.cR6. But, in campaign 'E' neither gang is present. Were they working on another project at that time? Was a big team like this in the habit of peeling off men, and leaving them on other sites?[30] The possibility that a team might split up into a number of separate gangs, and then re-emerge as the occasion demands, poses a number of tantalising questions. If they split, who lead each part? Would the master of that part follow the methods of the chief master, or would he follow his own ideas? Would he change, or perhaps modify the corbel, or even the structural geometry and basic foot measure?

Alternatively, was the big team of 1200 no more than an *ad hoc* amalgamation of a number of smaller teams combining together to handle the bigger jobs? Does the independence of the gangs reflect this? and was it preserved during this time of large contractors in their habit of moving off on their own every now and again? Here are a host of possibilities, but none can be answered from the one building.

The teams also seem to have been divided between those on the site and those at the quarry. Later English records show that many contractors were domiciled at the quarries, travelled to their work, and returned there when it was finished. The greater quarries which produced stone for many buildings, not just for the one as at Berchere, would have become centres for training, and possibly also the homes for their men. The quarries in the Oise basin which provided the stone for the sculpture would have been one of these centres.[31] Some of the sculpture may have been carved there and shipped to the

RUBY-M, 1206

1. As all work on the south porch is now, virtually complete, the drawings will only show the northern side. The central stone of the S.c gable has a Stretcher figure, and on the throne note a ladder - III:39/a.

2. Began the buttress around the SW(p) door - GEOM:III-D.

3. Erected David from **L**11, and some of the kings.

4. Forker group - see the left hand of Moses carrying the heavy stone tablet with the same loose delicacy as Abraham holds his son. See all the similarities with the S.e figures in the firm line which separates the beard from the cheek, the symmetrical claw-like curls, full hair, stances and particularly the dress formed independantly of the body. The folds are more extravangantly Forker than any others which is why I put them into the latest possible Forker campaign. The leaves on the column held by Moses in L3 are by *Braid,* like those under S.cL4.

6. It is not possible to say who carved John, N.cR4. It is such an individual and wayward work, yet it has many of the 3M folds (as in the Virgins in the N.e), but there is nothing of Ruby in his dragon, face or eyes. The over-stylisation of every part, from which comes its impact by over-emphasis, includes the longest fingers in the cathedral, the highest eyebrows, the thinnest body, and so on. Yet if we remove the emphasis we have a not un-Ruby like figure with the basic characteristics of that team - of stylisation, bodyless clothing, and so on. In a way the use of emphasis to denote character is a further indication that we may be dealing with Ruby.

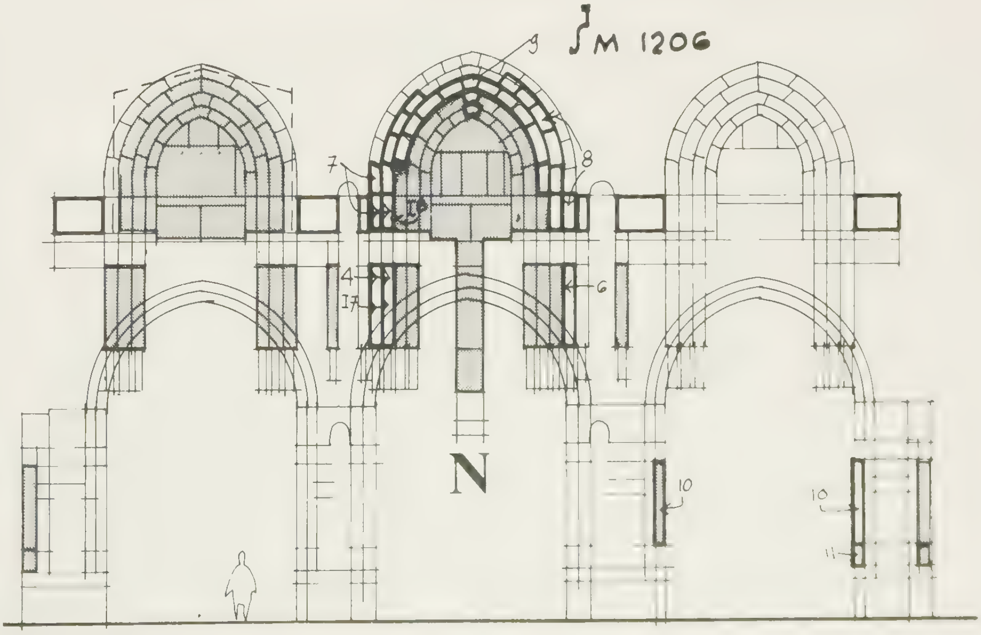
7. Forker/Thomas figures, with their vitality, eyebrows and hair.

8. Crown heads with leaves by *Frills.* The rest of rows γ and δ were carved in pairs and threes, with most of his gangs participating.

9. The N.c α keystone has the clouds, wings of Ruby, and was cut at the end while the arches were being erected, to suit the actual space left - **H**9.

10. The inner pair of figures on the piers of the west door. They have the heads of the S.c lintel, with raised eyebrows, the hair, ears and hands of 3M. The leaves under them are drilled and finely carved, could be anybody. Though the folds of the clothing are 3M, they are less stylised and finer. The whole composition is softer. They sit on plates, simpler on the west and more complex on the right. Their spirit is too calm for the crew which produced Abraham, yet what of Isaac?

11. N.w-wE2 tabernacle is bigger than the others, and the maple leafed shaft under it is taller. The leaf and berry could be Rose or Cobalt, the figures could be Bronze or Cobalt, but there is a sense of Forker in both. Problem.



site in barges. However not even all the sculpture comes from the one face, or even from the one quarry. I tried to disentangle the gangs by analysing stone types but without success, though I did find that the quality of Cobalt's and Ruby's stones were the best, and that Scarlet's was the worst.

I agree with Delaporte[32] that the decision to add the four outermost statues in the side southern doorways was taken after the lowest course of their doorways had been laid. He pointed out that the torus course underneath their Solomonic supports had been recut at some stage so that a small shaft could be added on the inside, for the groove formed by the original moulding which frames the columns can still be seen as a cut in the ring of the new torus. We can date the decision from two items. As the ring supporting the top of the Solomonic columns is not bonded into the wall like the others, the change must have happened after this part of the wall had been laid in 1199. The latest date can be determined from the porch piers, because by adding these statues they had to increase the number of rows in the archivaults,[33] and this reduced the width of the lintel over the porch.[34] As the outer piers of the porch were designed for these reduced lintels, they must date from after the decision.

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32. Delaporte, 1959. These four statues are marked with a black dot in n.10. The shape of the torus mouldings cut *in situ* are different in each doorway. Was the S.e cut by Scarlet and the S.w in the next campaign by Bronze?

33. The innermost archivault lies against the tympanum, and over the pier or shaft adjoining the door jamb. The others sit over the wall figures underneath, which is why the central door has five rows and a typical side door has four. The outermost central statues lie on the shaft supporting the lintel, and so have no archivault.

However, the side doors in the south, instead of having fluted shafts under the lintel, have these four figures. An extra archivault was added, and the width of the lintel reduced. Study figure over canopy - PHOTO:369.

34. The geometry of the piers, and therefore of the lintels will be found in GEOM:XVI-A. The difference between the lintel and its support on the inside is taken up in the gigantic canopies over the outermost statues. They are built of two courses, one of which supports the statue while the upper disguises the difference between the levels of the lintel and the impost. See vertical geometry in GEOM:XVI-B.

35. IX, GEOM:XVI-A.

36.

Mâle, 1948 suggests	1218-20
Vitry, 1929	1225-30
Schlag, 1943	1230
Aubert, 1949	1230-50

If I am to be proved wrong in this, then someone must show how it would have been possible technically for medieval masons to so accurately insert these giant canopies under the existing lintels, and against preplaced stones on either side, while producing joints that are among the smallest in the building. The side of each canopy adjoins the carved panels under the lintels with perfect joints, and on one the moulding around the panel has been extended into the canopy. The alignment of the moulding from one stone to the other is accurate. If the stone had been added the joints would not be as close, and the mouldings would not fit as well - you only have to look at the head of the door into the sacristy in EN.III to see how these things were usually handled.

Further, it must be shown that the statues could be inserted and pinned into place without being damaged, for there is no spare space above the statue to work in. It must also be demonstrated that this could be done while the aisle vaults were supported on top of the lintels, and the outer row of archivaults on the canopy itself. If it is thought that the canopies could have been added over the wall, and not set deeply into it, just look at the way those over Modeste and Potentin have sagged. The apparent exception, S.eL4, was tied back with iron cramps, not because its canopy moved, but because there is no ring between the statue and the Solomonic column underneath - **G**15 and **K**12.

37. Fully illustrated in Houvet, 1919-21.

COBALT-N, 1207

1. Cobalt begins the shape of the NE.31 window, and for the confusion around NW.31 see XV:14.

2. N.cLε6 is like N.eIN,R3 in n.38/S2.

3. All three statues are by different members of the one gang. The individual hands of each can be found in the N.w lintel. Sheba, L2, has much in common with N.c-e3 in stance. She was not meant for this side of the wall, but for the other as her face has a curiously bent look which disappears when you squash yourself against the door. Then suddenly the face becomes radiantly beautiful. She was designed to look to her left, and was therefore to have been placed against the left embrasure.

Solomon, L1, is a curious figure - female, pregnant, lack-wristed like a woman, he now represents the essence of kingly wisdom. Was this meant as an allusion to the Virgin, the patron of the Seven Liberal Arts, or was it originally meant to have been a woman, perhaps forming a female trio on the west side? However their history may be finally unravelled, these anomolies show they were erected some time after they were carved.

4. The N.w α angels are set into a wide moulding and are like the right hand lintel figure. The tympanum was cut in the next campaign. See n.8.

5. Two figures seem to have been carved at the one time. Their clothing is like S.wL4, and the folds of the adjoining N.c-w3 are not unlike. I am not at all certain about some of these. The quality of cutting and the vitality is not like that of most of the members of this team. Could they have been carved by Scarlet-P, or, more likely, Olive-Q? Their work is not well known here, and we will have to reassess this later from other buildings. Their leaves are very beautiful, and may be Cobalt-*Dredge* in N.c-e3 and *Maria?* in N.c-e4.

7. The head is like N.wL1, with the cloak and general fall of garments, crown pattern and flattened scooped cuts of Cobalt. The leaves under the pedestal are those of *Stitch*.

8. I could have placed this with the previous group for many slight reasons. However the clover leaves under it are those of the S.eL4 canopy, n.12/51, by Cobalt-*Clover*.

9. The tabernacles under the N.c-e figures have many connections with Cobalt. The twisted rings over them, the classical detailing, and its sharpedged folds match some of the south pier panels - **J**8 - and particularly the N.eIN figures of 1212 in n.38/S2. The leaves under the tabernacles match his elsewhere, *Dredge* etc. As the central lintels were not erected until this campaign, the tabernacles would probably not have been carved earlier, and therefore represent the most advanced of Cobalt's work in the cathedral.

The varied detailing, the deep cutting and the geometries used in their patterns all remind me of Cobalt's patterns in the north porch pier plinths - III:39 - in the panels over the N.e-eE

Since the piers were begun by Scarlet in 1200, this must be the date they decided to add the statues. There certainly were a lot of changes to the building that year, including the double ambulatory to the apse, the walkway round the outside of the sanctuary windows, and the lightening of the design for the porch.[35]

The importance of this observation is that these four statues were not carved some time in the 1220's, or even in the 1230's as some historians have argued,[36] but some time between the decision to include them in 1200, and the placing of the lintels in 1204. This date will not suit the accepted sequence for the history of French sculpture, for these figures are considered to be too 'advanced' for that time, and because dating at Strasbourg and Reims has come to depend on it. Yet just consider some of the sculpture that is generally accepted as being part of the building work and is unhesitatingly dated around 1200: the priest and king to the right of the S.e lintel, some of the Jesse figures and their attendants in the N.c archivaults, and the crowded figures on the lintel underneath.[37] Without belabouring the point, none of those four figures are sufficiently out of keeping with these works to force me to reconsider the earlier dating.

Further, there are such strong connections between them and the south porch pier panels and the archivaults over them, as well as with the work in the N.w doorway and the outer north porch arches, that the whole question of dating by style becomes somewhat questionable. Theodore at S.wL4 is no more 'advanced' than the magnificent figure of Judith in the N.w doorway; nor is Laumer S.eR4 more 'classical' than the N.c-wL High Priest or some of the uppermost Contemplatives -N.eIN,R5 &6. They are in fact individual creative works from the hands of very rare men working in one of the greatest periods of human artistic endeavour.

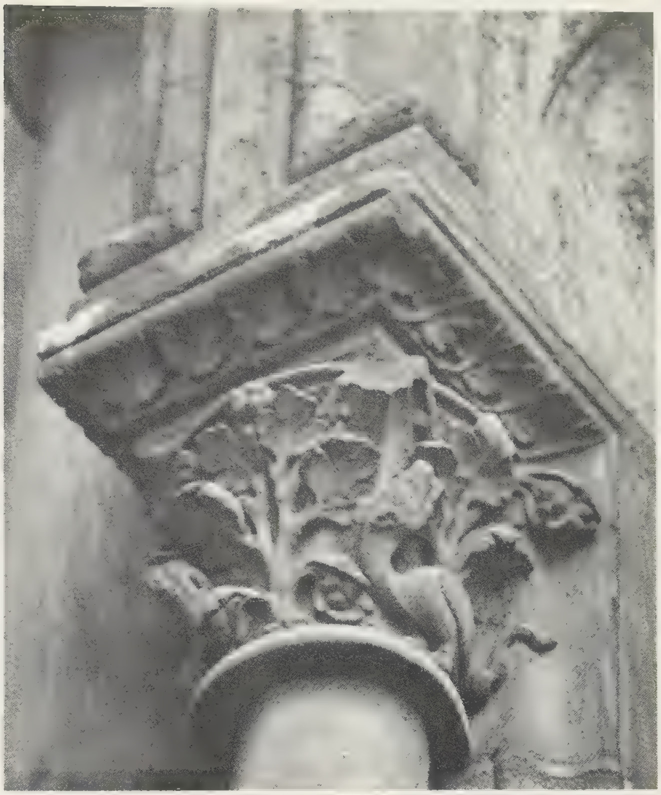

PHOTO 391: One of Cobalt's capitals in the piers of the north porch from 1207. The joint between Cobalt and Rose in the next campaign is indicated here by the displacement between the capital impost and the next course.

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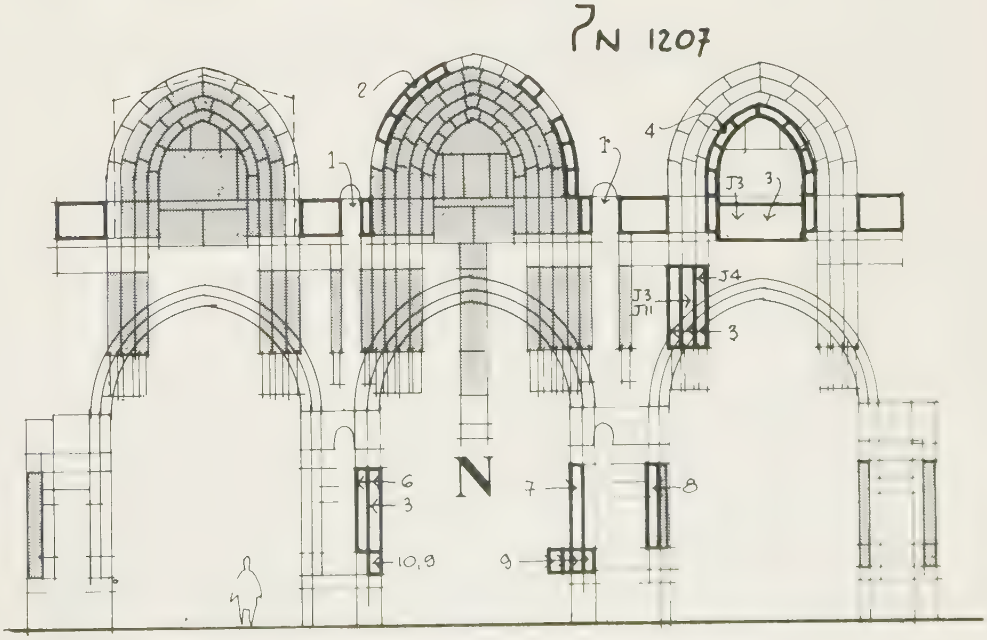
lintel - XV:24 - and in the south panel canopies - XI:10.

10. The tabernacle and the upper course of the plinth in N.c-e1,2 were not cut for their frames, with heads poking out of trefoils set under small hip roofs, and so on. Jusselin, 1915-22, quotes documents concerning work being done to a statue in the north porch. The date of the document is 1271, which would accord well with the style.

Something had been built here earlier, for the capital matches the others supporting the N.c lintels, even to the wreath of leaves round the impost - n.38/J2 - and its cities are in the style of those in the doorways. So the canopy could not have been carved 60 years later. The situation may have been similar to K12, where the sudden urgent need to finish the lintels may have forced the builders to put up a temporary support. Alternatively the pier and the sculpture on it may have been damaged, or perhaps the statue had sheared off its column support, or the support split down the grain. Who knows.



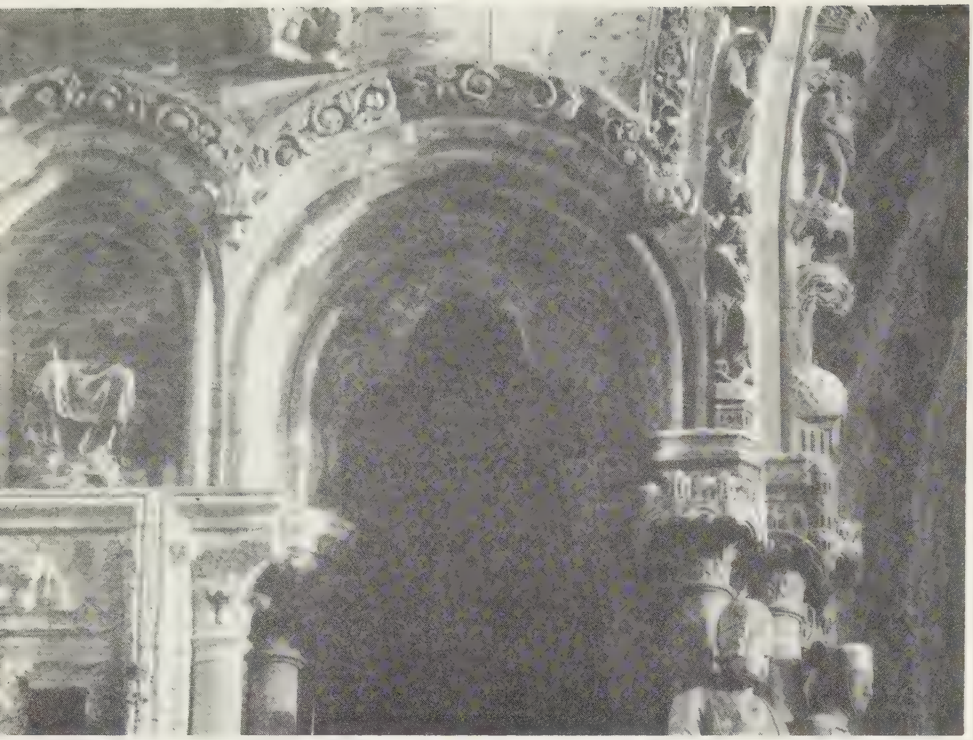


PHOTO 392: The upper eastern side of the N.c. Notice that the lintel flanking the central door is higher than the others, discussed in GEOM:XVI-B on the next page. Rose carved the caps on the left with the course underneath, and Cobalt did those on the right with the trefoil arch inside the king's recess. The outer row of Creation Figures probably by Scarlet in 1215, while the band of leaves and animals around that could have been Bronze.

I am aware of van der Meulen's unpublished theory that some of the outer figures of the north porch may have been added during the Renaissance - there are details in some of them which can remind us of a later age. The theory is not totally impossible, and has been argued with much skill, though I suspect that much of its appeal lies in the waywardness of the theory and the obvious difficulty in arriving at a final proof. However, I believe he is wrong, and I intend like Sauerlander to attribute the sculpture with their tabernacles and canopies to the contractors of 1200. Where in doubt I would prefer to accept the simpler explanation to the more complex, particularly where there is little evidence for the latter, apart from 'style'. It is simpler to build the porches with their supports and statues at the one time, just as it is simpler to build the porches themselves with the rest of the building, and simpler to build the doorways with their walls and piers than to cut them in later.

I believe that unless there is firm, indubitable evidence to the contrary, we should always accept the simplest explanation and, in architecture, that is that any stone lying underneath another must be, in the nature of things, the earlier one. It is curious how often scholars have rearranged the sculpture of Chartres to suit themselves. It is obviously easy to write that this or that part was added, replaced or otherwise modified at some later period - perhaps easier than accepting the stylistic problems involved if they were all done at the same time. Stylistic analysis must follow the facts, and if the arguments in this book come to be accepted, then the

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BRONZE-O, 1208

1. The 'roof' may have been removed, and the last archivault row installed, with figures like S.OUT in **L**2, and like later ones in N.e OUT in n.38/X1. Note at the top two figures very like the Strasbourg Church. So?

2. The clothing is closest to N.c-w1, and the facial expression to N.cR5. Links are in the faceted cheeks underneath the eyes, the loosely held finger, the contrasting folds, and the way the beard pushes out from the chin. There is the same light polishing of the surface as in the S.wL figures, with similar patterns - **E**1 - but with a small ball in the upper centre of the recessed diamond. A superlative pattern. The technique is the same, and only the arrangement has altered.

3. The patterns are even closer to S.wL. The hem has the same double projection on folds as in N.cL5, and eyes and forehead. It is like S.wL in hair, brows, stance and neck. It has the same circular pattern along the hemline finished with the same dotting, as in S.eL1 in **E**5.

4. The face is like N.cL5, as is the enfolding cloak, the beard, the forehead and the waist.

5. Eyes and furrows of N.cR5. Others in the archivault may be his too.

6. All three are by members of the Bronze gangs - the clinging cloth, the style of drapery, small eyes, high line of eyebrows, fine hands and wrists. Three masters with one spirit. R1 has the convoluted hemline and deep cutting of S.eR in **E**7, and is like some work in the N.w tympanum. For the leaves under Jesus ben Sirach see page 371.

R2 has the drapery and liquidness of the woman in the right N.w tympanum. She appears narrow, but is in fact twisted on her stand. If seen from one side she is no smaller than most other figures. There are stong connections between the cloak, form of clinging cloth, and position of arms of R3 with N.c-w4 and N.cR6. They must have been erected in the next campaign.

7. The canopy is trefoil, drilled and webbed. Could have been Cobalt, but I prefer Bronze.

8. The Christ in the tympanum is the same as the Blessing Christ in the NE.II boss - XV:43: heavy lower lip, posture of arms, the neckline with a layer of material over the left shoulder like the angels on either side of God. The central parting and general features are like those of God himself. The cloth has the heavy viscosity of this gang.

9. N.wL β1 wings were used in S.OUT in **L**2. See *Jubé* n.40.

10. N.wL γ2 kneeling figure like N.c-w1 in ear, hair, head shape and fall of cloth.

11. Group of three carved together by? lions, double groove in webbing etc?

12. In N.wR δ1 the cloth over the back of the figure falls as in S.wL4 in **H**3. Wings like the angels in S.OUT.

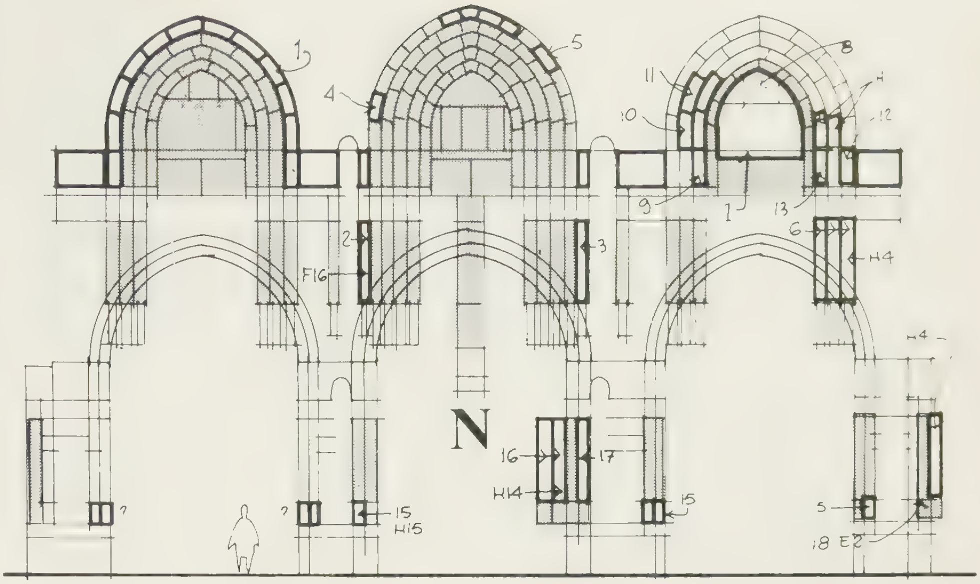
13. The dragon has the same head, comb etc as in Solomonic columns N.cL3, S.cR3, see X:51, and XI:24/d. Just as small an item is the pebbled finish in its canopy, which is Scarlet's motif - **G**2. Leaves could be *Tips*.

14. The last of the tabernacles carved either here or in **L**14.

16. These two figures were carved together. The links with N.cR6, L6 are obvious with strong scoops, plate-like cloth also of S.wR4, in **H**1. Note the hands and feet, the fall of the cloak, and the swings into the body as in N.wR3 and N.c-w4. The leaves are Bronze-*Groovey* in 1 and 3. It is above all the strength of these figures, their strong personalities, which puts them apart from all other gangs except Bronze, or Cobalt. This is the Elevation/Job gang, who in Bronze's next appearance in 1217 did not do any sculpture. See the comments in the text on changes in gangs.

17. The long face, and shortish arm is not unlike N.w-wW1 in **L**15, nor unlike N.e-e3 who I attributed to Cobalt in **N**3. Many of the folds are of the N.cR6, N.wR3 type, and the leaves underneath belong to Bronze-*Groovey*. These outside figures show the marked change in style and attitude which has developed in this short decade. S.wR4 is in this group - cloth, hands, line of face, planes of cheek structure, and fascination with observed detail, chins and nostrils.

ʒO 1208



SCARLET-P, 1209

1. There are connections in stance, cloth, hands etc with many N.c OUT, especially L3,4.

2. In N.wR δ6 are the wings of the *Jubé* Adoration - n.40.

3. The N.wR δ5 angel is like one in N.c OUT, R2 - hair, wings, scooped cloth, the vigorous pose, and the feathers.

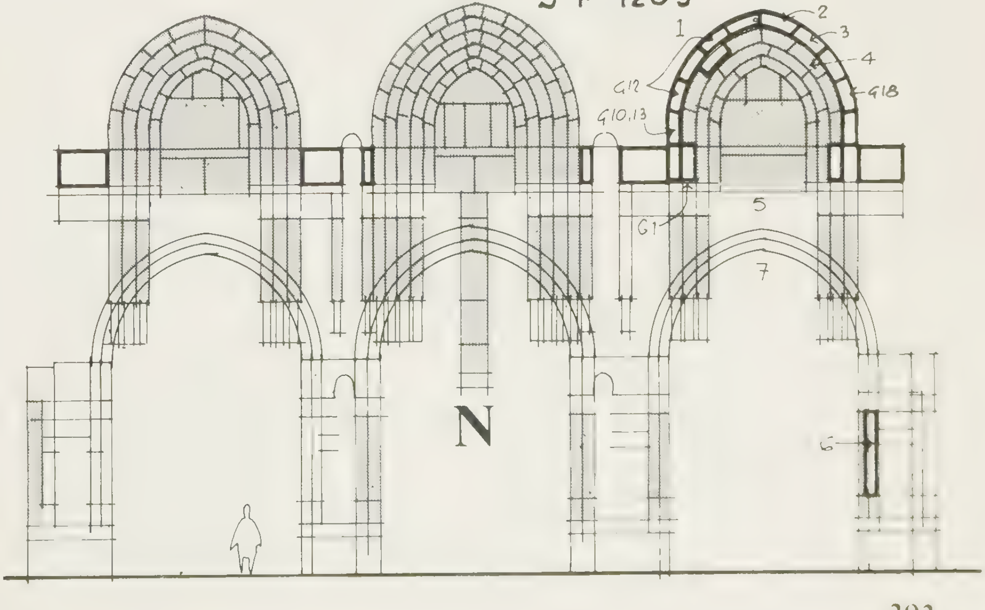
4. I cannot place these four. The rich folds, and the cramping of the tall figures. Some faces are like Cobalt in N.eIN,L5,6 but they have none of his sense of organisation. Problem. Olive?

5. All porch and door sculpture would have to be erected here and in Olive's campaign. See XV.

6. May be Scarlet's. The cloth and cloak are like S.cR β5 in **G**5, but there are also connections with Ruby. An open question. It is not connected with Scarlet's other work in N.w ε or in N.c OUT in n.38/VI. Olive again?

7. Voge has given the whole of this doorway to the one master and his atelier, and has called him the King's Head Master. I believe that the situation is far more complex than that, and that his KKM covers too many separate hands to be distinguishable as one individual, or even as one gang. Nearly the whole doorway is the work of three separate crews, whose work we have found elsewhere and who, unlike Ruby or Rose, are more interested in the realistic flow of cloth and the naturalness of the body. None of the stylised gangs are here, and this is in itself enough to give a sense of unity to the doorway.

ʒP 1209



traditional ideas of the evolution of Gothic sculpture which were evolved in the last century will have to be reassessed. If in the future we discover firm evidence that some of the statues in the north do date from the Renaissance then this part can be re-written. But until then the building should be allowed to speak for itself in the simplest possible way, and we should try to see what is seen rather than what we might prefer to see.

A blow by blow description of the building of the north porch and its outermost sculpture would be more than tedious, so I have described it in the next note.[38] In sorting this out I could only begin with the firm dates we have for the commencement of the piers, and end with the building of the buttresses and doors over it. Between these firm and datable extremities I marked all the alterations in sizes and templets that showed where there were changes in masters. I then looked for items that were recognisably the same as work done elsewhere in the cathedral by one specific master or his gangs, such as *Pruner's* leaves, Bronze's corbels or Cobalt's geometric patterns. This was enough to show that the porch was gradually built over the whole of the two decades that separated the plinths from the roofs. The many smaller details which could not be firmly donated to one master or another were left in abeyance, but I found over the ensuing years that I could find something to tie nearly all of them to somewhere else in the building. My confidence in the arrangement, as in the chapter as a whole, depends on that consistency.

When we approach the cathedral today our attention is first drawn to the porches, and then to the stained glass. They are the most photogenic parts and have been discussed by guides and historians much more thoroughly than the architecture. Yet we should realise that in the cost of the building the maximum amount that could have been spent on the sculptural decoration of the porches could not have been more than 3% of the total.[39]

It is small, compared to the importance it plays in the impact of the building, and very low compared to the amount of attention it receives from modern scholars and tourists alike. Yet the more I thought about it, the more I realised that the sculpture, great as it is, plays a very secondary part in the entire concept. Compared to Indian and Indonesian temples, compared to the incredible complexity of the sculptural program of Angkor and Yukutan, compared even to the sculpture on the

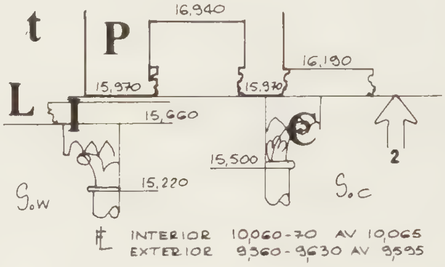
Geometry XVI-B

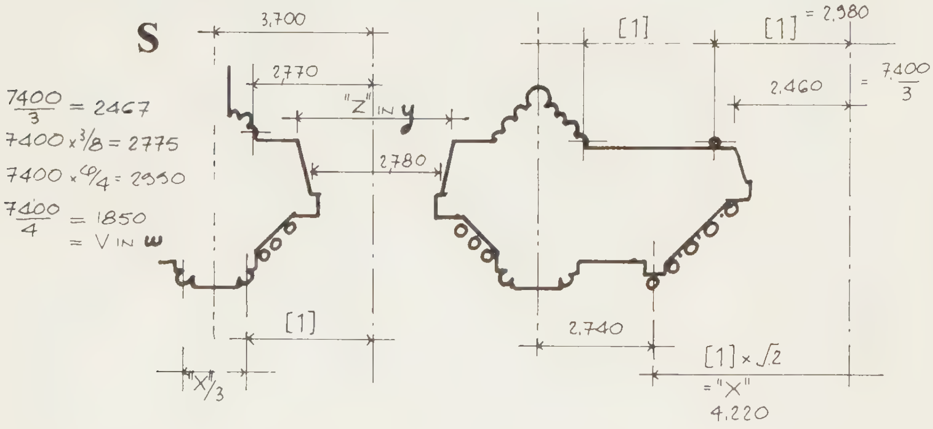
The vertical dimensions in the doorways, Bronze-E and H, 1198-1201.

We are fortunate that the doors which were set out by Bronze-E in 1198 were also fixed in height by Bronze a few years later, in 1201, when he laid the corbels in the south - n.12. The marvelous and harmonious proportions of these doors, among the lovliest in France, stem partly from the unity that Bronze was able to give them. The most important dimensions stem from the side doors rather than from the centre - I think because Bronze had intended to create a wider middle bay in the transepts, which had been squashed by Rose, GEOM:VIII-A.

The dimensions he used are so interwoven that it is almost impossible to determine the order in which they were evolved. The key dimension is the span of 22^{TF} across the aisle bay - GEOM:III-A. A quarter of this multiplied by φ gives 2,980mm (ironically just over Scarlet's 10^{RF}) shown as (1) in the plan **s**. Vertically it became half the height of the porch lintel from the floor, marked (2) in **t** and **w**.

The second basic dimension lies on the inside of the side doors of 2,770mm which is 3/8th of the span. Vertically it became the height of the column figures from the ring mould over the solomonic columns to the underside of the canopy in **w**. The third measures 2,460mm, or one third of the span, and formed the internal width of the central door in **s**, and vertically was used for the height of the column figures in the side doors in **v**. See how these dimensions were used contrapuntally in both doors. As all three derive from the interior axes, they themselves must relate to one another in the same way, as $2\varphi:3$ and 9:8 and $3\varphi:4$ (or $9\varphi:8\varphi:12$). It ensured that wherever the key dimensions were used these proportions will also occur.





The capitals, imposts and lintels of the side doors relate differently to those in the central door **t**. The side door lintel L sits over the canopy C so that impost I butts into it. The porch lintel P is placed over I. In the central door the arrangement is different. Though the porch lintels were installed by Rose, the height had already been fixed by Ruby's panels on the outside face of the wall at 19^{EF} to the top of I -XI:14/a and b. The height of the porch lintels alongside the central door would have been set a little higher than the others (as they were to be in the north), but at some stage (in Cobalt's canopies?) those to the side doors were raised to the same height as the middle. If this is a bit confusing it would be best studied on site.

However, the heights of the lintels were fixed

38. *The construction of the north porch.* For the lowest stones of the piers see III:39, X:49, and GEOM:III-E.

COBALT-J, 1203

1. The large capitals over the four diagonally placed inner columns by *Cross* in the east, and *Stitch* in the west.
2. The small capitals over the minor shafts are intricately carved, mostly with the closely observed leaves of *Brancher* and *Stitch,* like those he carved in the south panels, **J**8. His have animals on them in the east: one with a knight fighting one dragon while another trips him up. He began the motif of a scroll of leaves plaited round the impost of a capital, as in CAN.S.eR4.
3. The stone over N.e-eN is set back, showing he intended to project a frame around the outside of the porch, beyond any he might have placed over the other shafts. Next course by Rose.

ROSE-K, 1204

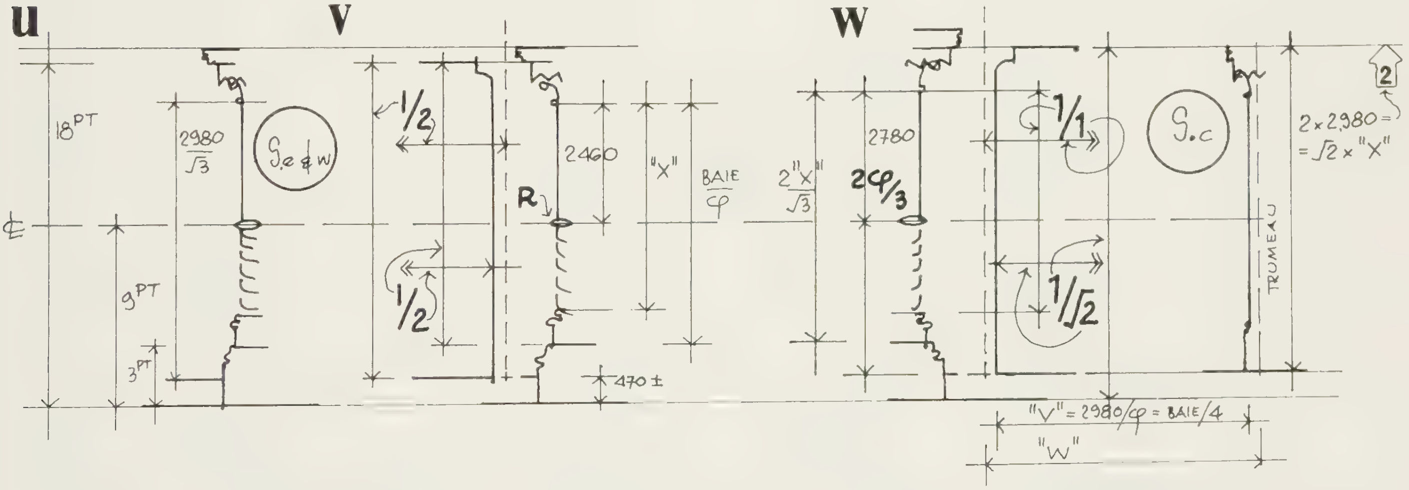
1. The large blocks over the pier arches are mostly giant single stones - XV:28 - with complex arch mouldings finishing over the small shafts with a squared-off moulding like a foot drawn in XV:25/**m**. Rose had used the same motif in the EN.II(t) gable -XII:38/IV. See how often the shape of this stone does not coincide with the capital imposts in the east, and the alterations made between it and the canopy course in N.w-e.
2. N.e-w interior panel - XI:14. This fixes the height of the lintel on the outside, continuing the height Ruby had established on the inside wall in the corbel over the N.e door, which had just followed Bronze's height from the S.w door - n.12/29 & 49.
3. Leaf on panel by *Cup.*
4. The small caps are the same as his in the south porch - X:56. On the inner face they are by Cobalt, as can be followed in the mismatched courses. The external figures which were destroyed in the Revolution must have been carved by or before Rose.

CONTINUED ON THE NEXT PAGE

39. I know of no contemporary evidence that they paid masons more for carving sculpture than for doing any other skilled work nor that this sort of carving was a special sort of activity assessed in a different manner to other details. In costing the cathedral (James, 1972(3)) we could not apply today's special rates to sculpture, so instead we struck a figure for each piece, irrespective of artistic merit, calculated on size and complexity. This gave us a rough and ready estimate for the time it would have taken to carve, and to this we added something for the difficulty of erection, plus 30% for thinking and designing time. Over and above this we costed the labour at 30% more than we would have paid a leading hand. After discussions with artists and builders in September 1972 we costed the figures in $ Australian like this:

wall figures at $7,150 carved and erected
archivault figures $850 max. per stone.
small lintels $5,800
large central lintels at $8,400 each
small tympani at $9,700 each
large central ones at $14,300 each.

The proportion between these figures could be readjusted without making any significant difference to the total. The full cost of the sculptural decoration, excluding capitals and cornices, was $A.1,270,200, and if adjusted to March 1975 prices would be just a little over two million dollars. See I:7; VI:45.

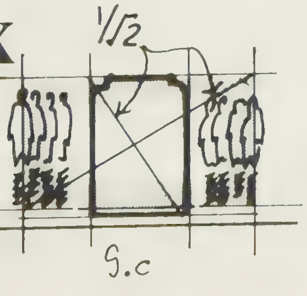


by Bronze, and were followed by the others in both transepts. In the side doors **u** he established the height of the impost from the porch paving using his foot, and in **v** used geometry for the verticals from the interior floor. Notice how the ring moulding R marks the exact centre of the side doors. In X:50 I showed that though Bronze began the solomonic columns, Ruby had put up the first rings. He slightly modified them so they measured 10^{EF} to the paving. Both Ruby's and Bronze's dimensions worked to the pointed *centre* of the ring. Similarly Ruby may have intended to make his statues 8^{EF} and 9^{EF} high (2,440 and 2;745mm), which are close to Bronze's.

The height to the underside of the canopy equals the height of the steps from the porch to the floor, and the space between them is √3 times the first key dimension of 2,980mm in **u**. In the central door the ring is below the centre. The door is twice the key length high, and therefore forms a √2 rectangle with X from **s**. It forms another with the door openings, both shown in **x** and modular ratios with the shafts (1) on the inside. There is also a double triangle in **y**, where Y is the 9^{TF} in **u**, and the Z comes from **s**. The trumeau's ratios are shown to the right of **w**. V relates back to the aisle span, and the inside width W is the space within the porch from the wall to the pier.

The dimensions of the north are substantially those of the south, in **z**. The reason for the shortened statues in **L**12 lies here.

X



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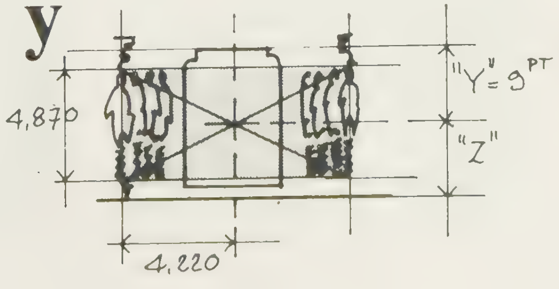


...III-C,E X:49 *...

5. N.w-e interior panel equal to S.w-w, see XI:14 and **K**.

BRONZE-L, 1205
(Lower darker shaded zone).

1. Outermost stones of the arch block, with sharper mouldings, and rosettes within the arch. Though shaped like Rose's, the mouldings differ. On the underside of each one there is a large bud by *Lobelia*.
2. A few of the small capitals use *Horn-Lobelia* motifs. He continues Cobalt's idea of a string of leaves round the impost. To N.w-e the leaves are those *Pruner* carved over the S.c Trumeau canopy, **H**8.
3. Tabernacles, statues, etc. **L**17.
4. Canopies with deep single windows, regular careful forms, with connections with Portcullis - n.12/**w**. See **H**15.
5. Panel by *Pruner,* with leaves matching his in south porch verticals - X:56/P.
6. Began the impost. The position of the joint shows that the whole of the pier had to be finished before the impost, and both before the lintels could be laid. There is no way the lintel could have been placed on the impost, and the canopies or the sculpture slipped in later.
7. The inside panels of the N.e-e pier and wall laid together by *Lobelia*. N.w-w panels similar - XI:14.
8. Leaves and vines of *Pruner*.
9. Laid the first lintels round the N.e door, with 3-foil arches - XV:24. This allowed him to continue with the NE corner buttress.

RUBY-M, 1206

1. Continued with the lintels to the N.e door.
2. Leaves over lintel - XV:24/III.
3. The last of the arch blocks, assumed to be Ruby because he used the round arch, and the leaf is like his in the lower courses of the north pier, being the 4x4 arrangement in the N.w-w lower course.
4. Three panels laid on the west end of N.w-w, by the *Plane* gang.
5. First of the decorated panels over the impost on N.e-e - XV:24.

COBALT-N, 1207

1. Laid the second row of decorated panels over the N.e-e lintels - XV:24.
2. Leaves over lintel - XV:24/III.
3. Set out NE.31 window, and began the east side of NW.31 - XV:14-15.
4. CAN.N.w-wW over Modeste and Potentin, which had already been carved by Bronze-L. Ruby's panels did not leave him much space for the canopy, which is why they have tilted. This shows how deeply the others are set in the wall - n.36.
5. Short shafts under N.w tabernacles covered with free-moving maple leaves by *Clover/Helmet*.

BRONZE-O, 1208

1. Forms the first of the recesses for the four kings, using the same section as he had used in the south porch **e**, X:56. See **K**3.
2. Carved the stone above this with *Horn* leaves. The top left corner was chopped out later to bring the band of leaves into it, and so this stone was carved before the one on the other side in which the recess is original. Probably erected after being altered.
3. Leaf band - XV:24.
4. Tabernacles **K**14.
5. Leaves like those in L8, but more vigorous. Does this show how *Pruner* has changed in three years.
6. Canopies like that over the S.c trumeau which had Bronze corbels on the side. These leaves are similar, and cities have windows of Portcullis type - n.12/**w**. **K**2.
7. Piers finally tied together with impost.
8. Portcullis canopy **H**15.

SCARLET-P, 1209

1. East side of N.w-w lintel - XV:24/I. At the same time he erected the wall figures in the N.w doorway, discussed in **N**3, and **O**6.
2. Over the N.w-w pier he carved one enormous stone which includes some pattern, and the king's recess, with a different silhouette to N.e-e, **f**. Not by Olive because the pattern is not as sharp as his work in the lintel, not Bronze or Ruby or Cobalt as these patterns are not like the ones they usually do. So must be Scarlet. Cannot be later than these masters because of the band of leaves on top - XV:24 and III:31.
3. Finished the west side of the NW.31 window - XV:14.

OLIVE-Q, 1210

1. Lintel N.w-e - XV:24.

RUBY-R, 1211

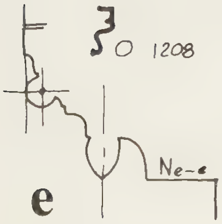
1. Finished the last of the N.w lintels, on east side.
2. Erection of the N.e vault can now commence, as the others are almost up, so it is possible to balance their side thrusts across the porch. He set the formwork, and put up one length of rib, with a section different to the rest **g**.
3. Carved the first of the N.eIN statues which will support the outside of the porch vault. Wavy hair, small eyes of S.wIN, R1 and 2, see **K**2.
4. Top of west king's recess, with rebate for band of leaves. Spandrels are filled with lobed leaves of *Dish*. Includes the first geometric pattern on the right - XV:24.

COBALT-S, 1212
(Upper light shaded zone.)

1. Altered the shape of the N.e vault ribs **h**, and began the patterns on the vault cells -XV:25.
2. Rest of figures in N.eIN arch. L4 equals N.cLε6, see **N**2; Venetian window under base of L1 like canopy N.c-e2; R2 not unlike N.c-w2, see **M**3 and 6; R3 discussed in **N**2; and R5, 6 by the classical carver of **N**9 (or could these two be Rose, **K**7?); L1, R1 like N.cLβ top.
3. Cuts lintels for N.c, erects both with High Priests in piers. He finished the outer archivault in the doorway and erected it. Central vault now ready for erection.
4. Canopies to N.c-wL have leaves similar to CAN.S.eL4 by Cobalt-*Clover*. Venetian windows - n.12/**v**.
5. Probably carved N.cIN, R1, and therefore the one on the left too.
6. He erected with the lintels the inner moulding of the arches between the porch vaults, including the back to the central king's recesses. It is made of two courses **i**, the outer part was laid later.
7. Leaves XV:24/III, over only one side of the lintel.
8. Began the little figures in the N.c vault which form the ribs. Cobalt, Red and Rose seem to be represented higher up, but I cannot be sure. Note the canopies have pointed arches and steep gables.
9. Laid the leaves over the decorative patterns at each end.
10. N.c tabernacles, though they could have been carved in campaing 'N', see **N**9.

RED-T, 1213

1. The one row of leaves over the lintels which are repeated in three places - XV:24/III.
2. Laid the ribs and vault between the lintels, with their different section **j**, and rather crude decorative pattern. They must be laid after the arch in S6, and as no one else seems to have used such a section before, I gave it to Red. On the inside of the NW stair he built the supports under the treads drawn in XV:15.
3. Continued the ribs in the N.e vault following Cobalt's pattern, and repeated



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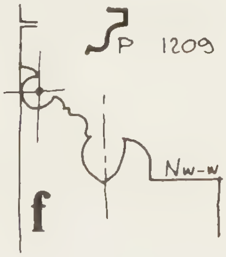

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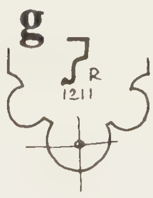

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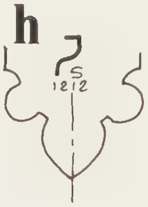

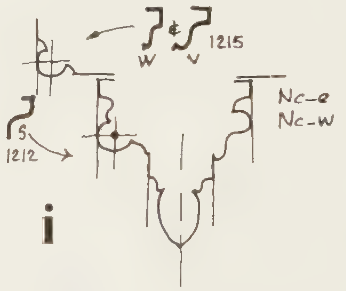

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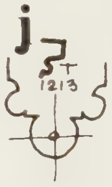

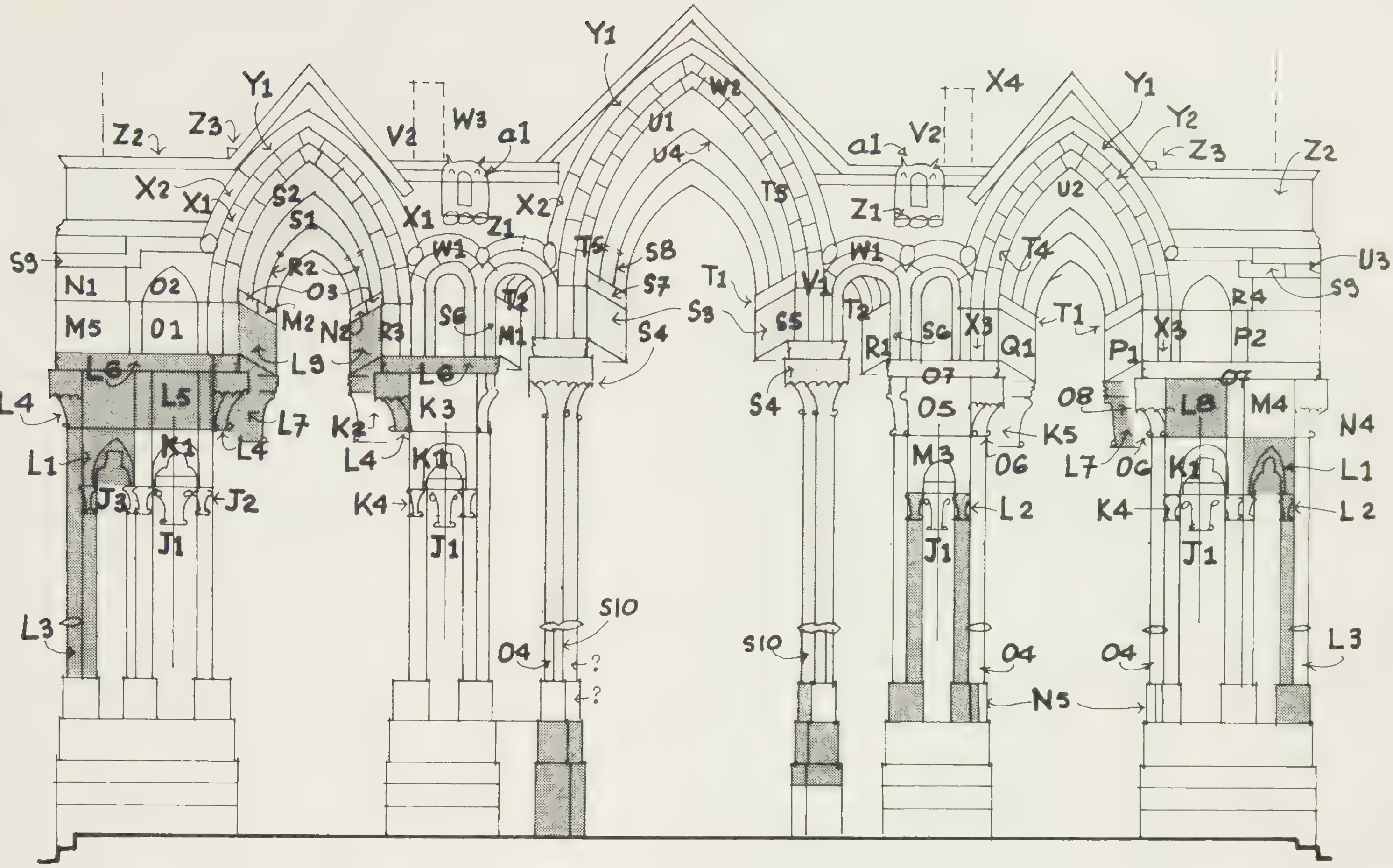

the same pattern in the N.w vault.

4. Carved N.wIN arch, with stiff figures, with an unsupple curious way of bending their elbows - n.29 and **E**3. The R3 shepherd and oak tree are similar to a figure in the *jubé*, n.40.
5. Much of the N.cIN sculpture, with thin bodies and bunched leaves, cannot be found elsewhere in the building, so I gave it to this crew which had not worked here before. Vaults cannot be erected until this arch is carved, as you can see in both side vaults.

ROSE-U, 1214

1. Sculpture in N.cIN only given to Rose because the quality of the work is better than Red's (assumed?) and because Rose would have to do it to get the vaults finished, and to complete his work inside the staircase.
2. Perhaps finished the N.w vault.
3. Leaves over the pattern on the N.w-wW, see XV:24.
4. Continued N.c vault, with his characteristic figures on the ribs, **K**3.

SCARLET-V, 1215

1. The outer moulding of the arches begun in S6 now added, with the first statues of the N.cOUT which are carved onto and integral with this course. The statues are by Scarlet, showing that the vault had been completed, so the outer 'trimmings' could be added. See **P**1, 2.
2. Began the N(p) buttress and roof gutters, GEOM:XV-A, showing that the vaults were complete, and the roofs over them well under way.

RUBY-W, 1216

1. Finished the outer moulding of the arches in S6, including the leg which butts up against the bottom statue of the outer porches. I gave it to him only because on the inside face of the north transept wall he was at the same time building the decorative arches which cap the top of the wall, and which have the same sharply cut line separating each arch - XV:40/s. It could just as easily be Scarlet.
2. Uppermost figures of N.cOUT.R could be Ruby. Compare the cloth on the figure of God with the loops on the Virgin's tunic in N.eL1 - **F**4 etc.
3. Continued with the doors onto the roof. As the roofing slabs were being laid crab-wise, as in IV:41, the inside is more advanced than the barge.

BRONZE-X, 1217

1. N.eOUT by the Modeste gang. The leaves under LI like S.c trumeau canopy. He did the whole arch, see **L**2.
2. The leaves around the outside of the arch are on the east very thin, symmetrical and undrilled, similar to *Horns* on some of the Jesse figures N.c, while on the east side of the N.c the five-pointed leaves are formed as a climbing vine which loops as in *Pruner's* panels on the south porch **L**4 -X:56. For the animals head see XI:24/d.Y.
3. Lower two in the N.wOUT archivault.
4. N(p) door corbels - XV:15/z.
5. In laying this string course, Bronze would have worked up to the support for the 'arcade' shafts on the east, and Scarlet would have done the same on the west -XVII:5 and 27.

SCARLET-Y, 1218

1. He cut on average three vine spirals per stone, following a pattern of involution and evolution, and with a flat leaf over the join. All branches are undercut. Could the heads of the animals at the bottom of these arches be Ruby? **F**15.
2. Upper sculptures in N.wOUT. The lion in R6 like N.wL β? and the two women on the right like his statues in N.cOUT, see **G**12.

COBALT-Z, 1219

1. Figures under the spouts have been replaced, but could have been his.
2. He finished the ends of the porch up to the cornice, but without drain or spouts. As these stones as laid vertically, they cover the face of the buttress, showing that the 'arcades' could have been continued over the porch long before it was finished, XVII:24.
3. Notice how the edge of the roof meets the cornice in a different way on each side - Cobalt and Ruby. On photographs taken of the porch before the roof was replaced there were upstands on the top of the barge for column bases. Doubtless they intended to continue the 'arcading' across the front, as in the south - XVII:2.

RUBY-a, 1220

1. As the spouts in the centre are like those in the south porch - X:56 - I think we can say that the roofs, and therefore the porches, were completed by Ruby in 1220, see **L**8. However this section may have been delayed while the 'arcades' over them were determined. See possibilities in XVII:4.

Parthenon, the porches at Chartres have a smaller role to play - and Chartres has much more sculpture than any other contemporary European building. Admittedly it is concentrated where it can be best seen by those who enter the church. It is not high in the air nor scattered uniformly over the surface, but is localised so it has the sharpest effect on the viewer.

There is almost no carved work on the inside, which is an architecture of space. In the porches it acts like the embroidered edge to a cape: it highlights specific points. It focuses rather than articulates. This is not to say that the sculptural program was unimportant - on the contrary it was of the utmost important for it made visible the essence of the doctrinal truths which underlay the great edifice itself. But at the time everyone must have been aware of the small sums allotted to sculpture compared to the vast amounts needed for the architectural fabric. Surely the churchmen who raised the money, and the people who made the sacrifices to pay for it, recognised that the most important part of the cathedral was the enclosure itself. The search for a simple, relatively unadorned architecture of masses and spaces, of rhythmic bays and complex geometry was the most compelling aim of the period, for which they were prepared to lay out the most prodigious sums, encumber their land with dangerous mortgages, and donate their jewels and heirlooms.

No matter how good the sculpture, nor how great our love for it, we must not forget that architecture, not sculpture, was the major cultural expression of the age, and on the basis of their budget, was immeasurably more important than anything else that went into it.[40]

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[40] *The remaining sculpture of the Jubé.* Mallion, 1964, believes that the *jubé* was built between 1230-40 because of the affinities it has with the sculpture of the north porch. If his connections are right, and we adjust his dating to suit mine, then the *jubé* should be placed a decade or two earlier than this. I do not want to enter deeply into it, for there is little to go on, and the stylistic problems are formidable. Do its delicate mouldings suggest a later date, or was delicacy more normal for decorative items within the building than without? Or does this delicacy come from the use of a softer stone than Berchere: Some of the capitals, canopies and porch sculpture is just as delicate as anything in the *jubé*.

With Mallion, p.181 I agree that a number of crews were involved. They would seem to be Bronze, Scarlet, Cobalt and Rose/Ruby with, doubtfully, Red. None of these crews worked together on the building after the early 1220's, and though I am not absolutely confident about the identity of all the teams working in the 1230's, I do not think Cobalt was one of them - ch.XX.

For these crews to have been working on the *jubé* while they were on the site we are left with the programs between 1210 and 1220, with my preference for campaigns 'X-a', 1217-20. If this is the date for the *jubé*, the connections between it and other contemporary sculpture would naturally have been as close as Mallion thinks. The *jubé* would have been finished underneath the temporary roof at the same time as the choir stalls which are documented as being completed in 1221, see I:3. It enclosed the 'temple-within-the-cathedral' from the west, and it is hard to imagine them building and occupying the stalls without the *jubé*.

Everything points to the two decades after 1200 being a time of extraordinary stylistic change, with a more rapid advancement in minor works than in major ones. The figures of the *jubé* have an archaic immobility and separateness that is much closer to the doorways at Chartres than the transept doors in Paris. Indeed, I would even add with some caution, that the outer jamb figures of N.c-w1 and 2 have a greater freedom, and supple humanity, than anything in the *jubé*. This tells us nothing about its date for ideas were changing too rapidly, but it does show that an early date just before 1220 is not impossible.

With this in mind I examined the remains of the *jubé*, and list my observations:

a. *Annunciation:* The folds seem closest to an Elevation/Forker combination (Bronze-Ruby).

b. *Nativity:* Possesses elements of Job, though also some of 'a'. The central column under the cot is octagonal, with concave sides only to be found in the north and south roses, and with similar bases and capitals. Mallion p.183 suggests connections with Modeste; Sauerlander p.48 with the N.w tympanum. To my architectural mind the column connects it with the Rose/Ruby group, while the Mallion/Sauerlander connections are to Bronze.

c. *Shepherd:* Like N.wIN.R2, doubtfully Red, see n.38/T3.

d. *Magi before Herod:* Like Solomon in N.w lintel (Cobalt - **N**3).

e. *Adoration:* Folds, king's head not unlike S.eR γ1 (Scarlet). Wings of N.wR δ5, also Scarlet - **P**3. All have smiles, an idea first found in the cathedral in S.OUT angels, and a few others in N.eOUT (Bronze).

f. *Waking Magi:* Like 'c' the crown has leaves of Bronze-*Lobelia*. Heads and cloth also?

g. *Presentation:* Cloth of S.w ε, and S.e ε (Rose?)

h. *Bosses of the Annunciation and Virgin in Majesty:* N.cOUT Creation by Scarlet. The Christ in Majesty has similar folds.

i. *Decorative panels:* Lion perhaps like N.wIN.R (Red - stiffer design than the others). Leaves are closer to Bronze gangs, or Cobalts?

j. *Column bases:* The larger ones have a depressed griffe as only Bronze used in the sanctuary. They measure 505mm across, or 1½^{TF}, his unit.

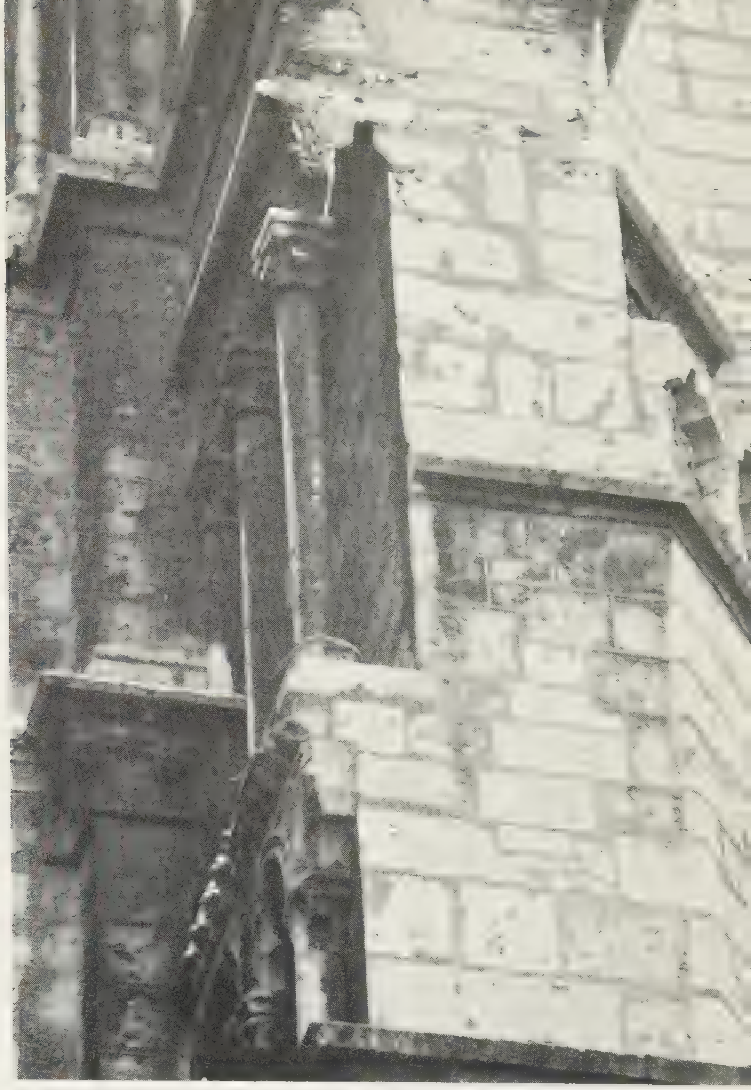
Thus if the design was begun by Bronze with his columns in 1217, the passage would have been vaulted by Scarlet in the next year, and the carved panels above could have been carved by 3 or 4 crews. This is also the time that would be needed to construct a major work like the timber choir stalls.

SEVENTEEN

The northern triforium

There are not many joys in human life equal to the joy of the sudden birth of a generalisation illuminating the mind after a long period of patient research. What has seemed for years so chaotic, so contradictory, and so problematical takes at once its proper position within a harmonious whole. Out of the wild confusion of facts, and from behind the fog of guesses - contradicted almost as soon as they are born - a stately picture makes its appearance, like an Alpine chain suddenly emerging from the mists which concealed it the moment before, glittering under the rays of the sun in all its simplicity and variety, in all its mightiness and beauty.

Petr Kropotkin



Above the simple gables of the northern porch we can see the beginnings of a two storeyed 'arcade'. Today they are only lying alongside the end buttresses, but they were obviously meant to be continued outwards. But how? The problem is intriguing. If there had been only one row of arches, the arcade could have been extended over the flat part of the porch roofs to form tabernacles as in the south. That something like this was intended can be seen on some of the photos taken last century by the Englishman Cruickshank.[1] Before the porch roof was repaired the barge moulding up the gable had included upstands for the support of columns above it as in the south.[2]

To have followed the southern scheme would have been the simplest solution to a single storeyed arcade. But a double storeyed arcade poses the most perplexing problems. How was it to have been built? Was it to have been carried over the porch forming a group of double-height tabernacles instead of the single storeyed ones used in the south? The idea would have been elegant, if unstable. Or had they intended to carry a two storey arcade right across the north front to screen the transept wall? If so the roof gables would have cut into both arcades, shortening the columns to nothing at the ridge. A twin arcade had been built at Dijon, but without the intrusion of gables.

If the pointed roofs of the porches had been left out so that its upper silhouettes followed the curved shape of the

PHOTO 399: The two-storied arcade on the eastern side of the buttress above the north porch. Examine the stones and the coursing to see that in spite of the obvious step in the bed joints the arcade was erected with the buttress.

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[1] In the Courtauld Institute collection; photos bought from the British School in Rome, 1949. Noted XVI:38/Z3.

[2] Were they built, and found to be dangerous, and demolished? Most of the statues in the Gallery of Kings in the gable over the west front seem to be much older than the niches which enclose them. They are very like the kings over the south porch which can be dated at 1205-7, while the western gallery cannot be earlier than 1245. Their average height is 2½ metres, again equal to those in the south. Note also their matching features, in sharp noses, and elbows and crowns. Had they been carved for the northern roof some time in the 1210's?

vaults the seating for the upper arcade would have passed comfortably over it. The entire proportions of the north would of course have been revolutionised. It may have looked something like the left of this,[3] perhaps with a gallery of kings as in Amiens or Notre Dame, Paris. There are so few screens in France that it is hard to visualise what they may have had in mind. We have to turn to Tuscany and Umbria, and to the fronts of Pisa and Lucca, to find parallels. As with so many other elements in this cathedral, the north front may have established a new artistic canon for northern Gothic.

The arches were begun as soon as the porch roofs were finished.[4] The carving of the arches themselves over the lower arcade is crisper than the upper ones, and its rosettes lie within sharply edged frames. Clearly the two rows are not by the same people. yet on the east the arch is made from two stones, and the inner one is just like the top row, in all respects. Unfortunately you cannot see this from the ground - you have to climb onto the roof of the sacristy to get a proper view of it. In the two diagrammatic elevations[5] the similar arches are shaded. Clearly the other type of arch X had to be carved afterwards, and therefore the crew which did the two

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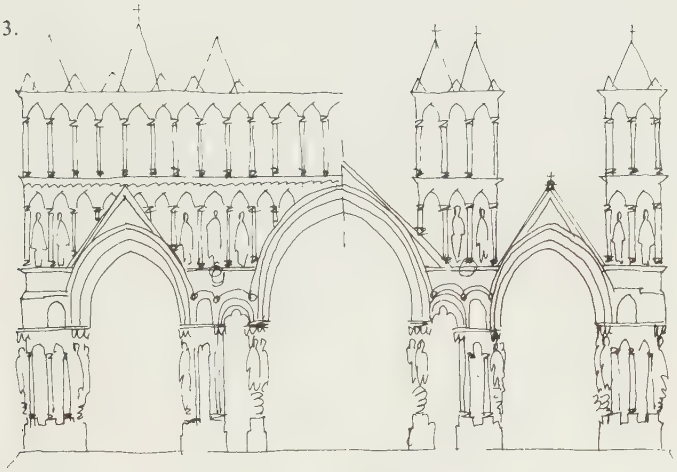


[3] Cobalt-Z seems to have been responsible for the upstand on the porch gables meant to support the arcade columns, though there is only one per gable, on the outer flanking side - XVI:38. No more were continued up the gables, nor were any to be seen between the roofs for tabernacles like those in the south. I conclude that in the next campaign Ruby-a eliminated much if not all of the screen.

Cobalt was also responsible for starting the second row of columns in the flanking buttresses - n.27. His successors continued them, though their work may have been limited to building into the walling as it was erected the inner parts of the arcade, so that the rest could be built later when the porch was ready to receive it. This was also the constructional method used on the south.

The upper arcade would have made a very unstable element if it had been carried above the lower one around the porch, yet it could not have been placed against the transept wall, as this wall was already set out, and would have imposed a weird outline on the arcade, with inclined sides to buttresses and prows. Maybe it was to have been set in front of the wall but behind the north face of the porch, and would have given the facade a more delicate look, more like Paris. The unadorned 'rear entrance' look of this wall lends credence to this idea, for then there was no need to articulate this wall at all, nor to make their stair-windows less conspicuous.

However in the photos in the Beaux Arts of the demolition of this porch roof in the '20's there is no evidence for such supports. Further, neither the arches, mouldings nor columns still in place show any sign of turning the corner onto the north face. So we are left with only two solutions - the two storied screen shown on the left of the drawing, or a two-storey repeat of the south elevation, Laon-like in its tenuous elegance, shown on the right.

Why have the implications of these arcades never been discussed? Are the problems posed by a two-storey arcade too embarrassing? There is nothing else like it in France, though a number of buildings, from Wells to Lucca, support multi-storied arcades attached to the wall itself. It is the free-standing quality of the arcades that is unique, not the proposal itself. As I said earlier the bare quality of the wall above the porch strongly suggests that it was not meant to be seen from the street. The entire feeling in the north would be different, and altogether more inviting, if this wall had been screened. Was it completed? If so when was it pulled out? Suggestions?

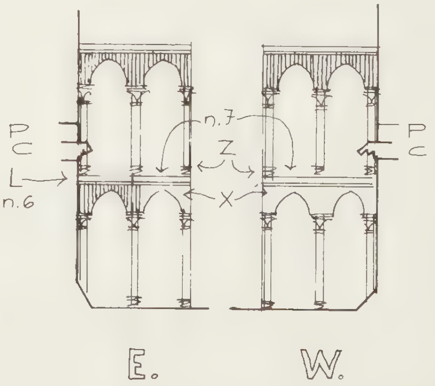
It was Cobalt who also designed the multi-layered arcading in the southern canopies, and in particular the two-storied ones over the large suspended porch-like arches over Theodore etc. - XV:12 and PHOTO:392. Ruby on the other hand never carved arcades over his canopies, but towers and battlemented walls.

[4] Van der Meulen, 1967, p.160, suggests that the arcades were inserted towards the end of the medieval period. Against this:

a. The bonding of the middle arches is irregular, and could have been added later if it were not for stone Z in note 5 which was set deeply into the buttress. The depth can be seen on the north side. The NE corner buttress was built over this course, without any reworking, on the east side -n.27/f.
b. The bonding of the upper arches is fully tied into the rest of the buttress, so they could not have been added.
c. The style of the upper and lower arches is equal in parts, and also different - n.5. An unlikely confusion in an addition.
d. There is no sign of cutting back on the buttress behind the arches. It would have shown up most clearly in the vertical joint in the NW corner - n.9.
e. If the arcade had been inserted, why is the upper recess shallower than the lower one.
f. The original barge of the porch had upstands carved in them to support this arcade - n.1.
g. One of the arcade shafts with its base was carved with a cornice - XII:6.

Grodecki, 1951, p.161 claimed that the buttresses had been cut back after being built: once below the lintels when the side doorways were supposedly inserted with their sculpture, and later above the roofs after the lintels 'broke' in 1316. His argument is largely based on these truncated 'arcades', and is satisfactorily answered by van der Meulen, 1967, p.163-4. There is absolutely nothing in the 1316 *expertise* to suggest that the lintels broke, or were even in jeopardy. See Lepinois and Merlet, 1864, ii, pp.172-4 which has been translated in Branner, 1969, pp.102-3.

[5]



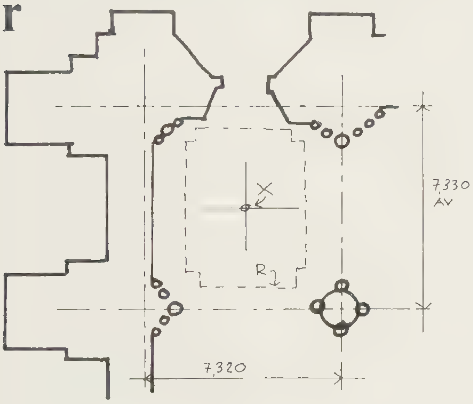
Geometry XVII-A

Layout for the interior of the rooms under the northern towers, Ruby-a, 1220

Ruby began by establishing the centre of the bay from the ground floor, and placed the space of the room centrally over that. In **r** X is the centre and the dotted line R the wall. Ruby could have established X within the triforium from the ground floor through the hole in the boss.

He formed a module from his English foot increased by √3 to 524mm, as he had earlier in GEOM:XII-D. On the inside he made the triforium, being arcade, passage and wall, three of these units, shown boxed on the right of **s**. This thickness is not related to the axis, nor to the arcade arch, but just sits over the filling of the vault - see the same method in GEOM:II-D, where I show how he subdivided these three units into the elements of the passage.

r



The space remaining from the inside of the triforium wall to the centre X was doubled to locate the western wall face. It then 'turns out' that the thickness of the west wall became 4 units, and also that the room width is 5:9 the height of the arcades, and also almost equal to the depth of the crypt below the floor, used by Ruby in locating his cornices in XI:20.

On the south side he made the wall one unit thick, and placed this centrally to the axis from the buttress to the pier. Again making the room central to the bay, he located the north wallface. I think he may have intended to make this wall 3 units thick, though the final thickness was the work of Jade.

At the bottom of the drawing I have shown that the overall thickness of the bay compared to the axial centres forms a ratio of 6:5, but there is no mathematical explanation for the intriguing consequence that the space within the room is 3:4 (though I should explain that the adjustments made in some walls so they followed the axes have slightly distorted these rectangles, so I cannot determine which was primary).

Within the room the pilasters form a band 1 unit thick, and incredibly, this leaves a *nett* room size of 1: √2 shown circled. The NW room was built to suit this geometry, but in the NE the eastern wall is thinner, having been started some time before Ruby arrived. This is discussed in ch. XII.

The tower rooms, here as in the south, are not isolated phenomena, but are parts of the whole transept. The overall width, measured between the external walls, is 30,450mm, which is 15:7 the main axes in **t**. In other words, the towers form 4 module blocks on either side of the central vessel. The aisle axes form a 9:10 relationship to this 4-module unit, so the tower walls were formed in much the same way as the nave walls in GEOM:V-A (7,320:8,120 = 9:10 and 8,120:30,450 = 4:15).

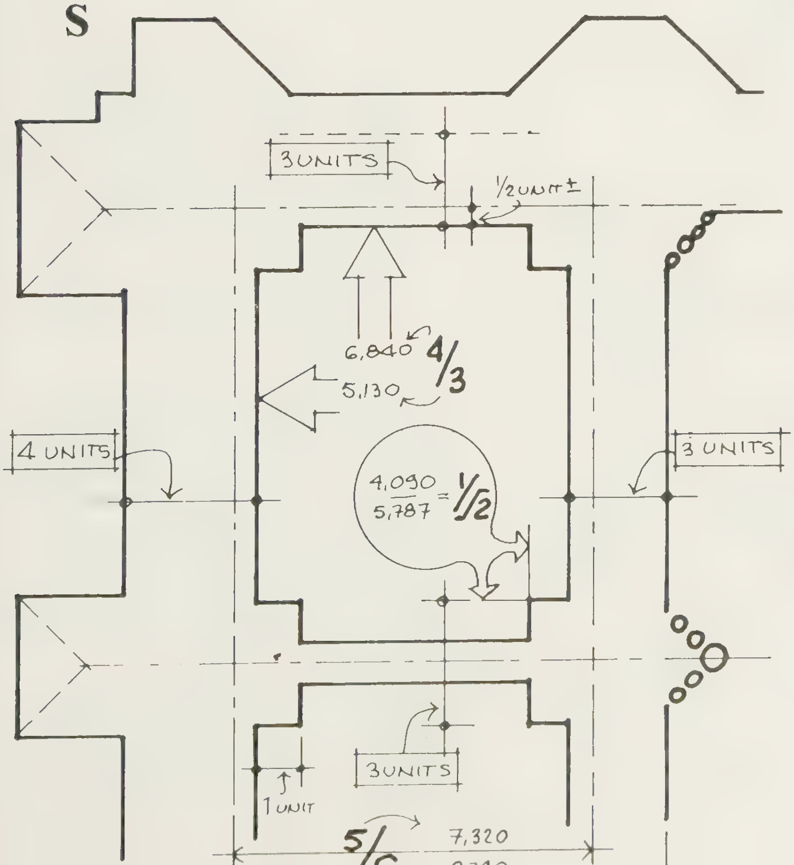
The space between the walls relates to the mass of the tower through a square and a triangle in **u**. The overall width of the transept is 120mm less than 100 of Ruby's EF, while the tower block to the shaft S is exactly 30^{EF} (30,450 - (2 x 8,790) = 12,870).

If Ruby had intended to place colonnettes along the exterior of the north as he had in the south - XIII:6 - then the nett north-south width of the tower of 9,460mm would have been reduced to provide a seating for the colonnettes by a distance similar to the one in the south, perhaps to 9,120mm. This would have completed the circle of relationships in **v**, by tieing the interior to the exterior through the ratio of 3:4 (6,840:9,120), and by forming a square tower if the internal dimension was to be taken through the vault shaft R, and lastly by noting that this square lies within 10mm of being 3/10ths of the overall width of the transept (9,130:30,430), repeating the same 3:4:3 ratio once more. A remarkably well integrated piece of geometry, as we have come to expect from Ruby.

Once again let's consider how differently the north would have looked if Ruby had laid just two more courses, and begun the same colonnettes as he had started in the south!

...XIII-A & D/*...

s



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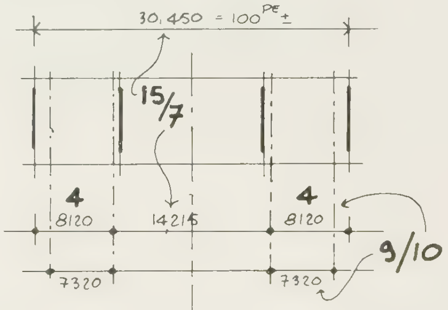

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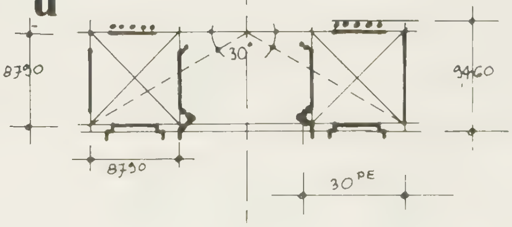

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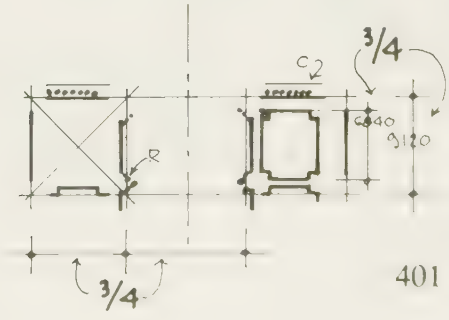


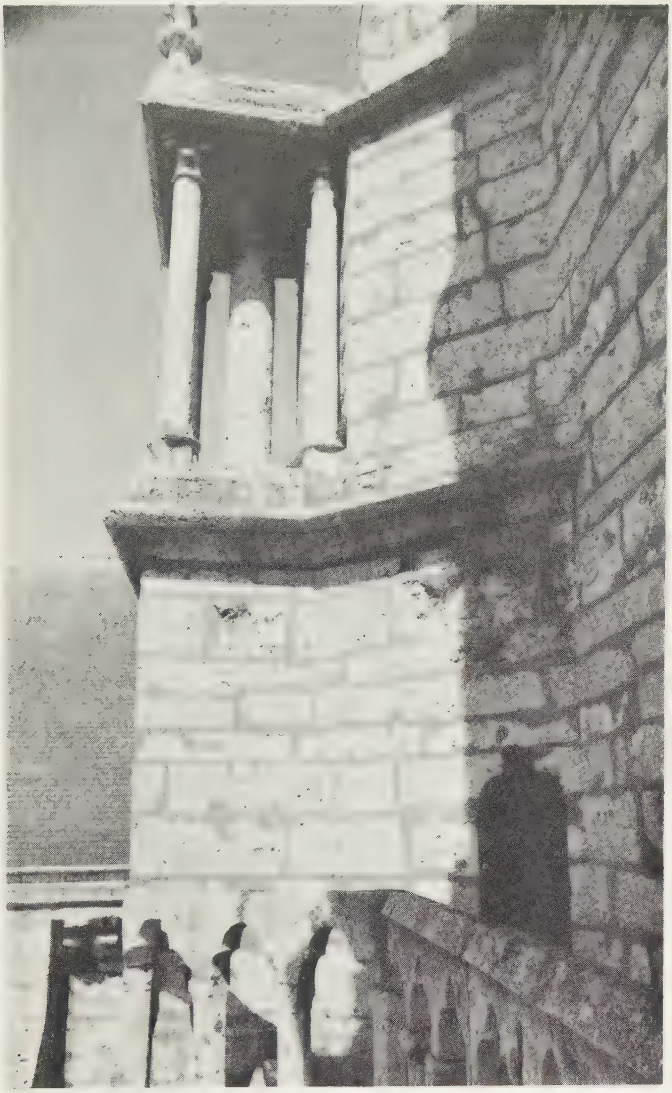


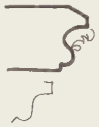
PHOTO 402: The north eastern buttress of the northern transept seen from the triforium walkway. The plinths discussed here are at the base of the walls on either side of the passage.

shaded portions were working in different programs. So our first clue must be to look for a crew which returned at both these times.

Above the bottom shaded arch there is a row of leaves L. The leaves project out of a flat moulding.[6] Next to them the moulding changes its shape and the leaves are more restrained.[7] On both the east and the west the exuberant leaves lie over the shaded arches, and the quieter ones over the crips arches X. Therefore the next moulding over the leaves, Z on the elevation, is the work of the crisp master. It is a thin stone and is set deeply into the stonework of the buttress, showing it was built with the rest of the transept wall. As the leaves are identical to some carved over the lintels of the north porch,[8] our second clue must be to look for the earlier crew among those who could have worked in both places.

On the west side all three columns to the upper arcade are cylindrical. However the first one passes through the edge of the cornice C, and the lower half below the cornice was carved as an octagon. This shows that the

6.



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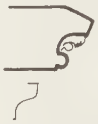
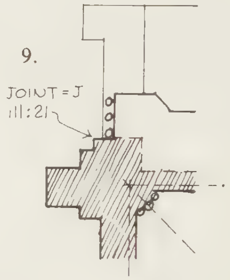


8. See work of Cobalt-*Clover* - XV:24/III.N.

9.



10. *Plinth course in north (t) rooms - 1218-24.*

a. All the work built before 1211 is hatched, and I have included in this the NE.II corner buttress, and the two piers in the NE room which are just visible above the floor. They were presumably placed to strengthen this part while the north transept was catching up. Those to the NW room must lie below the floor level - n.14/c.

SCARLET-Y, 1218

b. NW-S door, with same 60° construction used in the SE(t) door - XII:10.

COBALT-Z, 1219

c. Plinth to eastern passage with different splays on each side (100 x 22° on inside and 132 x 45° on the out). The only other plinths so treated are his - XII:10 in the nave. The tread on the south shown black is scooped out to lead the water away, so could it have been laid during the delay by Cobalt-S? The face of the wall over the plinth bends at ✱. From the bend and the corner in n.22/c I think three courses were by S.

RUBY-a, 1220

d. Placed the NE-S door in the centre of the wall with his usual width of 25″ = 635mm - XIII:7 /r - with a wall thickness which may have been calculated as the EF x √3 as 'arcade' was built with the cornice, even though the cornice does not meet the face of the wall behind the columns. The edge of the cornice has been broken, showing another joint. I found that before I could solve any of these unknowns I had to examine the area around these cornices. The missing clues will be found there.

While the porch, and in particular the N.w doorway, were delaying work in the north, the internal face of the terminal wall still had to be built, even if the outer skin was left off, so that the end bay of the aisles, walls and arcades, could be completed. In the plan the earlier work is shown hatched.[9] Meanwhile the northern buttress with the 'arcade' had to wait until the porch roofs were complete. This is why there is a vertical joint behind the first column of the 'arcade' up to the level of the cornice. It shows that the beginning of the 'arcade' must be dated after the north porch, and not with the hatched wall of the aisle.

Above the level of the cornice C the northern wall and buttresses are tied in with the rest of the building, for from here up the coursing behind the 'arcade' columns lines up on both sides. The first course above the cornice is a standard splayed plinth P under the triforium walls. The splay of the western corner is 27°, while the eastern is 35°. As elsewhere the pattern of different slopes can be divided among the crews, and shows that the western plinths were laid with those underneath the wall of the triforium passage, and was the work of Jade-b in 1221.[10]

My plan will not fully explain the order of the work as the heights of the plinths alter from one place to another. The outside walkway is 450mm higher than the room, and there is a 220mm step down from the triforium passage. The course in which Ruby began the shape of the room is underneath the course which fixes the walkway passage outside. Only sections and elevations can explain this fully, but before examining them consider the geometry of the plan, as it reinforces the arguments in the last note.

The rooms are set out from a series of rectangles, and these are overlaid with another system of diamonds, as

his interpretation of Scarlet's 1½^{PM}. It is set over an earlier wall (shaded) which is held together with metal ties. This wall is not parallel to his, and there is a joint down its centre which is apparent where it passes under the door.

e. Set out both rooms. His lowest interior course passes under the door plinths, and is slightly set in from Jade's - n.14/e. On the outer sides of the rooms his work is higher -GEOM:XVII-A.
f. He set out both north doors to standard size - XIII:7/n - though the jambs are partly Jade.
g. He carved one plinth next to 'c' in the NE corner, and another under the NW.III triforium. The former is butted against Cobalt's and projects in front of it showing he reduced the size of the opening intended by Cobalt. His plinths are like others by him in earlier campaigns.

JADE-b, 1221

h. His plinths under the triforium passage walls are 412mm wide, compared to Ruby's 402mm, the splays are varied, but average 110 x 30°. His doors through them are in proportion of 2: √3. There are no other doors like these in the building, 765 x 880mm.
i. Laid the outer face of the exterior walls, completed the doors, laid the cornice round the walkway - XII:6. Some cornices were inserted into a groove left under 'f', as can be seen under the NE-N threshold - n.15/g. The centre of the cornice is dished to allow the water to pass - n.11 - with spouts placed to suit the posts of the balustrade which was therefore intended from the beginning.
j. The plinths under the three western buttresses established the diamonds in GEOM:XVII-B.
k. He wished to reduce the width of the buttress above the cornice, but first laid a plinth and above that splayed its corner as in **a**. Not the same method as Cobalt had used in EN.IV - XIII:38/p. He also laid the inside plinths.
l. The NE corner stone, and the change in geometry discussed in the text after n.10.
m. The inner plinth of the NE passage is butted against 'c'. The splay changes, and the stone is 20mm lower. The next stone may be Bronze lying over a joint in the paving that may be Cobalt.

BRONZE-c, 1222

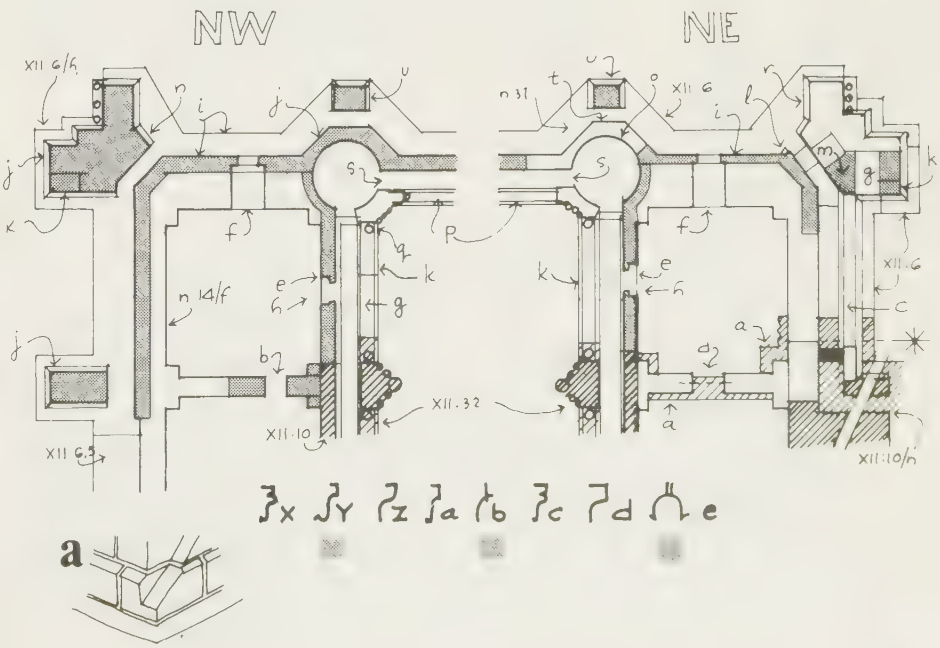
n. He changed the geometry of the NW corner in the next course above the plinth - n.12.
o. The joints around the staircase buttress suggest that Jade's work finished near the corners.
p. Laid the top course of the internal gallery balustrade the same height as the triforium plinths - splays 109 x 30°. For the joints at each end see n.15/i.
q. Column base is typical - n.15/j.

OLIVE-d, 1223

r. Built the outer part of the NE plinth with altered geometry to 'l'. His splay is 100 x 34.5° as in XII:10.
s. Placed lintels over gallery doors - n.15/r.
t. Widened north face of buttress - n.15/t.

ROSE-e, 1224

u. Reduced pier of buttress. Splays 118 x 35.5° are the same as his others in EN(t).II - XII:10/II.p. This base measures 1,723 x 582mm = 2√2:1 The plinth must be his, not Olive's, because the latter had widened the pier in his earlier corbel, and the plinth narrowed it - n.31.



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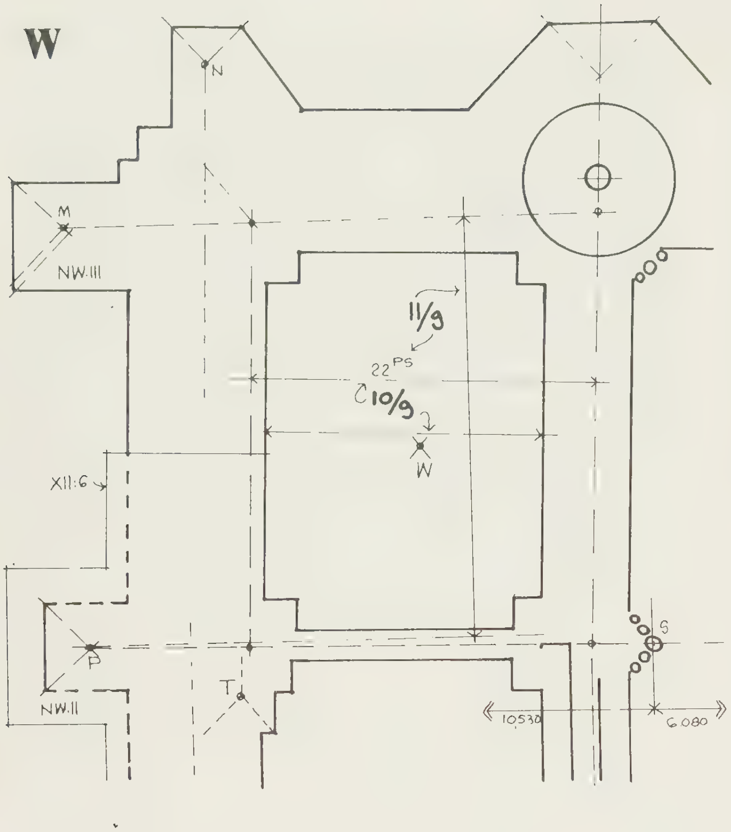

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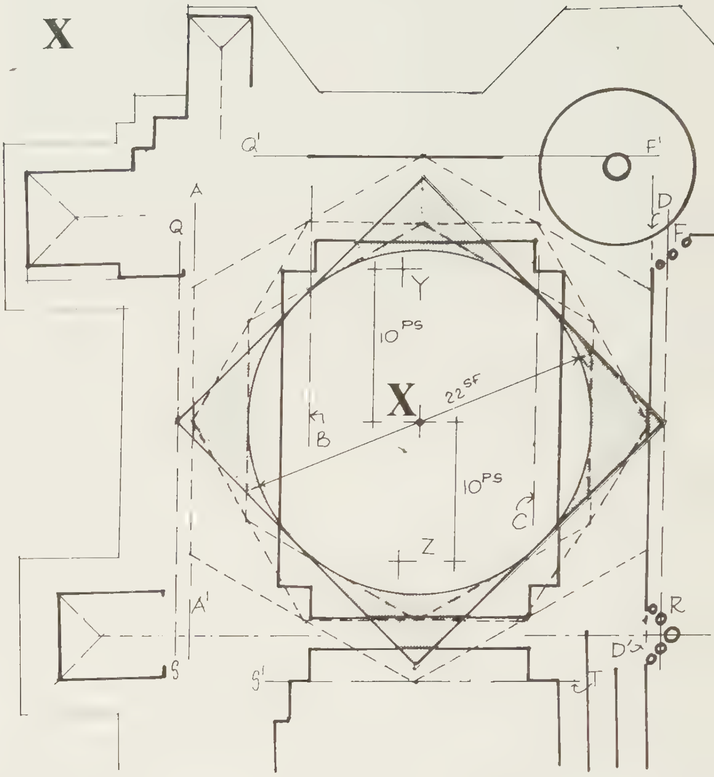


Geometry XVII-B

The external walls and buttresses around the NW room, Jade-b, 1221.

On arrival Jade found the solid black outline in **w** already laid out by his predecessor. He placed strings for the axes, and in most places was able to move them a little from Ruby's positions. The ones along the triforium passage and down the centre of the south wall were, of course, immobile. But the western one could have been set out from the NW corner buttress N, or from the SW epicentre T. He in fact chose a position 22^{SF} from the eastern axis. This is using the same 280.4mm foot as he had used in the SW tower in GEOM:XIV-C. This gave a ratio of 10:9 to the interior width of the room.

The NW.II buttress plinth was not placed along the line of the axis. Its epicentre P lies on this axis, but the rest of the buttress is twisted to the north. This twist is parallel to the axis through NW.III, and though it does not continue through to the interior shaft S, it does appear to maintain a relationship with the NW.III axis. In its plinth the latter buttress was narrowed - n.10/k - and the distance between them of 7,540mm forms the next ratio of 11:9 to his first 22^{SF}. The epicentre P was placed 10,530mm from the shaft S, which forms a hexagonal ratio to the half span of 6,080mm.

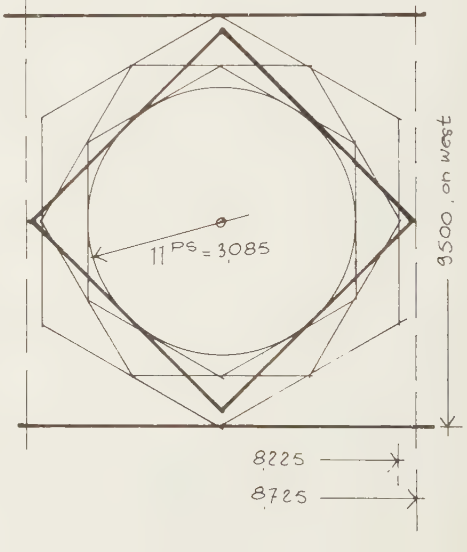
In the second move he retained the central location for the room X, inherited from Ruby. He may have been pleased with this, for in the SE(cw) he had gone to great pains to start the geometry from the exact centre of the bay.

Around X in **x** he drew a circle with diameter equal to the distance between the axes that he had made 22^{SF} apart. Outside that he drew the square and hexagons in **y**. The square shown shaded produced QS which formed the western side of the arch that Jade himself was to install a few years later - n.14/u. It also produced FR through the rib shaft R, just as in the SE tower. The second enlargement of the hexagon shown dashed, produced AA' and DD', the latter locating the outer face of the plinths supporting the triforium arches. AD was divided into four parts at B and C, which almost coincided with the face of Ruby's pilasters. As the pilasters lay outside these lines he made no attempt to alter the former.

The hexagon has been enlarged in three logical steps, the figure rotating with each enlargement. In the third and outer hexagon the face Q'F' marked the outside of the northern wall (and at the same time lay tangential to the newell!), while ST, when suitably twisted to suit the alignment of the south end of the room, marked the south face of the pilasters, shown in **x**. Y and Z were each placed 10^{SF} from X, and positioned the other way centrally to the axis OF and AA'.

In **z** a circle was drawn around each, to be tangential to Q'E' and ST. The splayed northern faces of the tower were set out from Y at angles of 2: √3, which comes from a variation of the hexagons in **y**. The epicentre of the NW.III buttress lies on NY, and the distortion of the axis that joined it from Q' to J is precisely parallel to NY. The line joining the

y



you can see in the adjoining geometry. The doors on the north lie on the centre of the diamond, and the walls of passages follow its sides. There is a second diamond which determines the angle of the buttresses. Its centre, which is not the same as the first, lies along one side of the door. It is an elegant pattern, like the design of medieval floor tiles. I wonder which came from what? The diamonds are the work of Jade.

However, the pattern is not the same in both rooms. The NW room follows the arrangement described in GEOM:XVII-B in all respects, but in the NE the outer diamond does not coincide with the side of the door, but lies a little to the west. What has happened to the outside buttress? are there two geometries from the one master? The clue lies in the plinth.

In the note on the plinths[10] the one marked 'l' is not in line with the adjoining one 'r', nor is its splay as steep. You have to get on your hands and knees to see that it points in a different direction, for the reveal is only 120mm long. But that is enough: by placing a long piece of wood against its face I was able to extend its angulation far enough to the north to be able to measure it. It was not cut for the present buttress, but for one just like the west. From careful measurements I discovered that the splay, when projected to the inside, exactly meets the other side of the diamond on the edge of the door -just like its counterpart in the west. QED: a change in the splay accompanied by a change in geometry indicates a change in masters. The first splays with the diamond plan are Jade-b, and with it he determined the general shape of the north front over the walkway and began the outer part of the buttresses: all of which can be followed in the geometry and the plan of the plinth course in the last note.[11]

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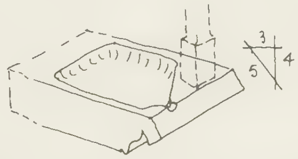
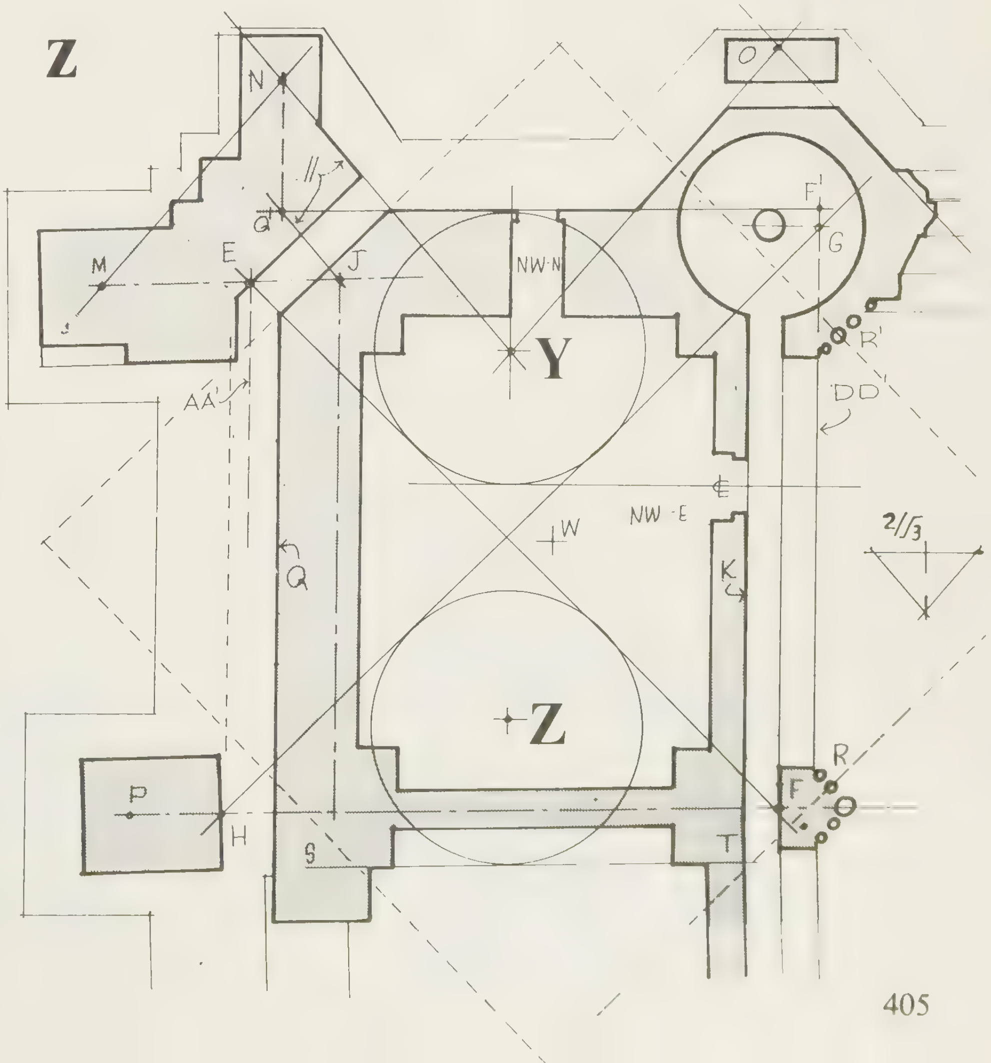
[11] GEOM:XVII-B. The walkways have scooped out sections in the centre to carry the water away from the joints. The same idea is used in the ES(a) cornice - X:12 - the over-paving to the north nave - XIII:5/e - the over-paving in the north sanctuary - XII:6/m - and over the south (rg) - XXI:21. The scoops in the north are bottle-shaped, unlike Bronze's in (a). Compare them with X:11. Those along the north side of the nave (t) are closer to these than any others. My major evidence for the presence of Jade in 1221 is the broken arches under the south towers (cw) - XIII:62 - plus the need for an unknown crew designing the diamonds of the tower rooms in GEOM:XVII-B and the doors into the triforium - n.10/h. Afterwards I accumulated a lot of secondary evidence to back it up. It is one of the less well identified camapigns. Jade-g is much firmer, for I have his arch, two corbels, many bases and capitals.





epicentres M and N is also parallel to the line from Y to O.

A pair of lines were run tangential to the two circles, forming a cross. E lay on the intersection of the north side of the NW passage with the III axis from M, and also met AA'. H lay where the west side of the passage through the buttress was intersected by the axis from P, F where the east side of the triforium met the same axis, and G meets the line through the centre of the newell and DD'. Notice that Q'H is tangential to the newell. So these diagonals are space locators, positioning the outer faces of the ring of passages that frame the tower.

The centre of the NW-E door is also tangential to the Y circle, while the 'tangent' line through one side of the NW-W door passes through the centre of this circle, Y itself.

The outside walls of the room, K and Q, are each placed from YZ to form the ratio of 3:5 with it. Q lies 30mm inside the III axis from N. They do not coincide, but were kept distinct. No fudging.

Lastly there seems to be an encasing square as in the SE tower, but there are not as many indications for finding it. Obviously it passes along the inner face of the NW passage, and if it also passed through the rib shafts R and R' it may form a square whose centre is the axial centre W in **w**, and whose outer circle's radius has a 2: √3 ratio to the first 22^{SF}. Maybe.
...XIII-B & C/*...

Though colonnettes could have been set over these plinths, I do not think Jade intended to repeat the solution used in the southern transept on this side. The central buttresses projecting from the stair enclosure are narrower on the north than the south, by some 430mm, which would have made the nett buttress after leaving space for the colonnettes too small to be useful. So, at the time when Jade was completing the colonnettes on the south he was committing the Chapter to a totally different aedicular scheme on the north.

His successor, Bronze, followed Jade's general concept for the front - indeed, he had little choice if he was to maintain any sense of unity - but he altered the geometry from Jade's diamonds which integrated all the thrusts acting on the room, to a group of simple equilateral triangles. On the west, at 'n' he laid the course above the plinth, and eased it over slightly so that more of the lower course is exposed on the inner end.[12]

We know it was Bronze, for at this level his corbel appears over the door from the room into the triforium passage. Indeed, we are fortunate in this area that all six masters, from Bronze in 1222 to Ruby five years later, left their corbels over these openings.[13] The joints between them are not always clear, but by examining all the surrounding work, and putting all the details against one another, a consistent picture has emerged. I have drawn elevations through the rooms looking south towards the crossing,[14] and sections through the triforium passage looking north into the stairs,[15] and have listed on

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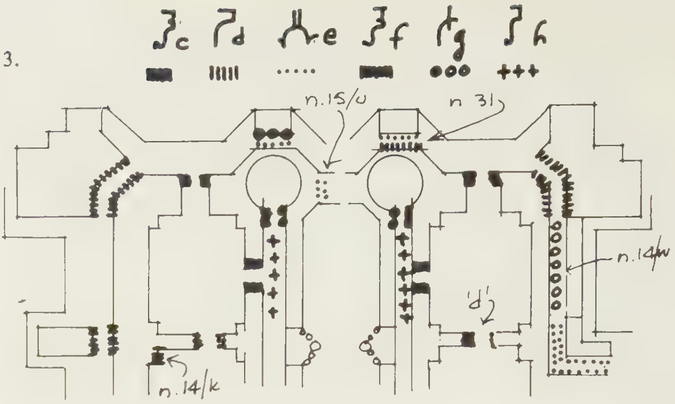

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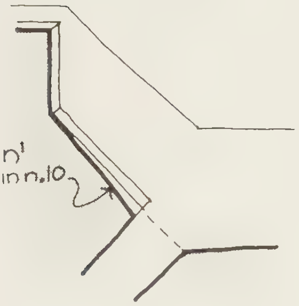


13. See drawing top right of this page.

14. *Elevation of the south walls of the northern rooms.*

a. The aisle vaults are by Ruby-*Lobby* in the NW and Bronze-*Dish* in the NE - XI:34. Vaulted in 1216 and 1217 showing that the western room was head of the east. This tilt was maintained from then on.

b. Corners of walls were reinforced during the delay. Probably in 1208 by Scarlet-O, See XII:11/p.

c. Cornices n.10, discussed in XII:6. The jagged broken joint on the inside of the NE shows that part was laid before the vaults, with the drain in XII:41/h. The position of 'b' under the corner pilaster, and the butt joint against the jagged work, suggest that this wall was to have been thicker.

SCARLET-Y, 1218

d. The joint steps down as there is a delay in laying cornices. I assume that the wall to the west was some courses lower while the north transept wall was being built and materials were brought in through here.

RUBY-a, 1220

e. Set out both rooms. Note the thinner wall intended in the bottom course, as this is indented. Corner pilasters are butted onto earlier work - n.10/e.

JADE-b, 1221

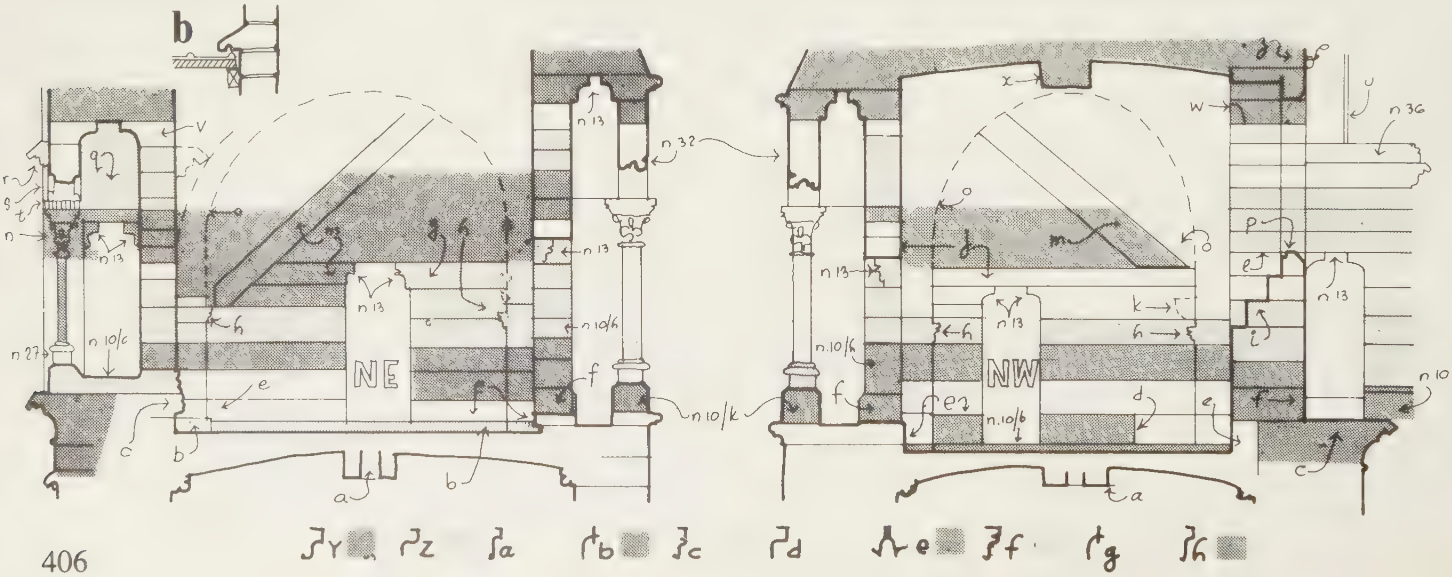
f. Set out the external wall to the room on the west. The wall is here 2,190mm thick compared to 1,350mm on the east. The aisle wall is 800mm smaller than this, so part of the wall sits over nothing - or on an arch, or on the fill over the vaulting. This was Ruby's decision in GEOM:XVII-A. The space Ruby left between the internal wall and the cornice was wide enough to accommodate either an arcade or a screen. Finally Jade just left the outside wall face plain. Scarlet/Cobalt began the passages on the east in both transepts. Ruby began the screen over the wall in the SW room west face. So the lack of either screen or passage must be the work of someone else - Jade.

BRONZE-c, 1222

g. Corbel over NE-S - n.13 and 16.

h. Bronze began the springing. They are the same in both rooms. There is an upstand over the impost for the start of the ribs. It is an unusual idea, and the ones in the apse vault may also be his - XIII:56/f.

i. The stepped beginning to the NW-W



window like his in the SW-S - XIII:50.

OLIVE-d, 1223

j. Olive lintels in long thin stones as in south. No masons marks.

k. The bulbous corbel on the other side of the wall - n.30 - because you can follow the coursing round the corners to the south side to include his corbel over the NW.II buttress passage.

l. Began the window with a joint immediately above it - n.29.

ROSE-e, 1224

m. The flashing course in the NE was clearly laid after the springing and with the corbels, and on the NW after Olive's corbels. The original stone may have looked like **b**.

n. Capital Rose-*Cup* - n.27/j.

o. The stone is recessed to take the flashing, and this is followed by a square-edged arch as in the NE. So both arches on the south of the wall were begun by Rose, preparing for a circular vault cell.

BRONZE-f, 1225

p. The plan of the window changed above the sill - n.29.

q. Raised the buttress in the SE corner as a pier to support the arch of the flyer - n.27/l and text after n.28.

r. The cornice under this work is one of Rose's old ones, re-used. Was Bronze in a hurry - XIII:44/c.

JADE-g, 1226

s. The arches identify him - n.27/p.

t. Packer placed over the impost to raise the arch - n.27/o.

u. Began the arch on the west with a small arris along the corner. From 'f' this would have been his intention when he set out the room.

v. Similar concave corbels over the eastern passage, probably Jade.

RUBY-h, 1227

w. Three-foil arch over the NW window using the same form he had used in the SE room -XIII:3 - and in soffits over stair lobbies -X:50. The outside finishes with a small chamfer. He completed the arch 'u'.

x. Bosses in both rooms match Ruby's in SE room in XIII:53.

GREEN-i, 1228

y. Supporting corbel under the centre of the arch with the leaves he used at the top of the same tower - XX:37/g. As the central pier of the tower sits over the voussoires of the arch he was taking its weight on the corbel. A structural problem not recognised by Jade.

15. *Section through north triforium passage facing the stairs.*

RUBY-a, 1220

a. Room plan - n.10/e and 14/e.

b. Gallery G, doors and ballustrade - XV:41.

JADE-b, 1221

c. Plinth, and begins top of balustrade on the west without a splayed edge. The joint is next to the chamfer.

d. Built plinth by the broken coursing against 'b' on the east.

e. Double treads.

f. The column base was left standing on its own, so it was probably built with three of the steps leading up from the passage to the stairs, (each of these steps is numbered) and finishing with the top of his tread 'e'.

g. NW-N threshold inserted later to match NE-N. The door was completed with the outside face of the wall - n.10/i. In the NE-N door only the outermost stone in the wall is his with the cornice C.

BRONZE-c, 1222

h. Vault spring and impost - n.14/h.

i. Top course of balustrade with splayed edges. On the west the square edge against the splay shows position of joint with Jade in 'c'. The rounded end on the east shows that there is no joint here - n.10/p.

j. West triforium column base with a cut corner under the torus. The junction with the respond is not even to 'f'. Probably with the three treads up to the stair door - n.10/q.

k. The east side of the NE-t door plan with 'h'. The west side seems to be Olive. The door entry is one course higher than in the NW.

l. The west side of the NW-t door is also Bronze, but with a recess for a door swing - so it may be Jade. The east side is by Olive with his base 'o'.

m. The vertical joint inside the NE stairs is also visible outside by Olive's window 't'. It continues down to the walkway cornice.

n. Double treads, and possibly the single in the NW stair.

OLIVE-d, 1223

o. The bases over the balustrade with upturned corners. The one on the west is like the north aisle window of St Pierre at the other end of the town - also by Olive?

p. The engaged portion of the NW arcade column. It is the only one on the job. It was not used by him in other parts of the arcade. A new idea? The joint lies over this.

q. The packer over 'f' shows where the joint is in the NE between Jade and Olive.

r. The flat lintel over the NE gallery door is the same as in the S(t) rooms.

s. Single treads.

t. NE.84 window - n.24. On the inside he has cut his stones with a laye, roughly, and with pebble-filled joints as he had 13 years earlier in the triforium walls, discussed on p.22. At the sill he widened the buttress 25mm to 1,685mm, or six of his smaller feet, being $\surd 3{:}2^{CF}$. He used 6½ of these for the height of his door lintel 'r'. The position of his corbel on the outside is dotted in.

ROSE-e, 1224

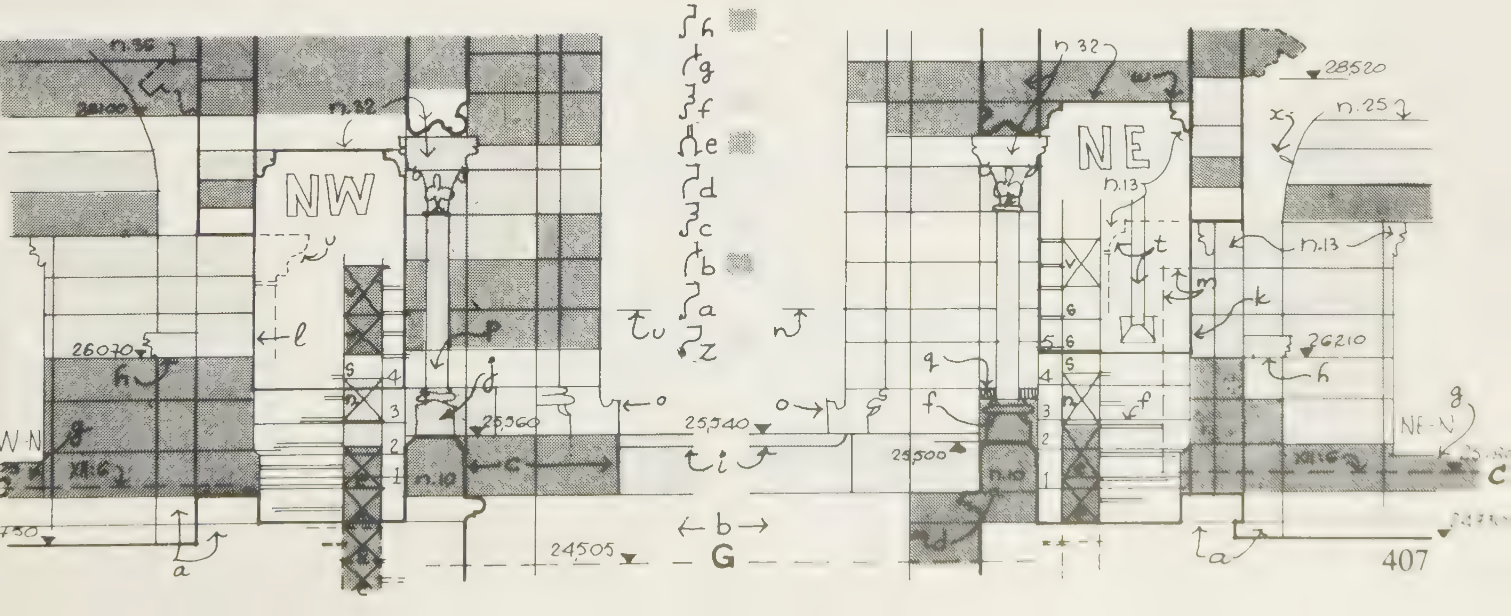
u. Corbels placed over the gallery door, 1,960mm up or 6 times his CF. The corbel and the lintel look broken, but in fact the space between the corbels is filled in with a piece of stone to close in the top of the door opening. There is a joint over this course as the shape of the buttress has been altered, but outside it includes the next two courses with the corbel, shown dotted within the doorway.

v. Double treads.

BRONZE-f, 1225

w. The corbel to the NE door is in a yellow stone, showing that the joint lies underneath it. Uses stone from the same part of the quarry as in the E(cw) eight years before - XIII:46/h.

x. The shape of the NE rib changes in the third course, to an arch radius of 2,860mm. As this is 8½^{TF} I assigned it to Bronze.

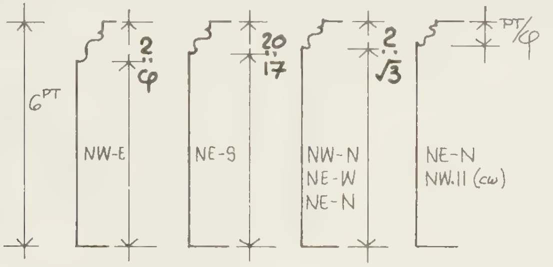


them all the information that has led me to place the joints where the shading indicates. There are eleven Bronze corbels altogether, showing that he finished both of the doors on the north side of the rooms, and both into the triforium passage, as well as another from the NE room into the roof space. We will discuss this latter in a moment.

Compared to Bronze's earlier doors the vertical geometry has changed, and the shape of his corbel has become smaller, with more delicate mouldings. This may indicate a change in the master leading the team from death or retirement, perhaps around 1216.[16]

Opposite the Bronze corbel over the door from the NE room into the roof there is one by Rose.[17] Further into the corner and along the same course, there is a long inclined stone set flush with the wall. It can be seen in the elevations. From outside it can be seen to follow the rake of the roof. It is a flashing course which projects over the roof to stop the rain from running between it and the wall. It is a unique idea and is not found in any other part of the cathedral.

16.



The flashing starts just below Rose's corbel, and is therefore by him.[18] The Bronze corbel on the inner side of the door shows he worked before Rose. We now have the team order of Jade-Bronze-Rose. Moving to the NW room the door into the roof is capped with Olive's corbels which lie two courses below the start of the flashing course, showing that he, like Bronze, worked before Rose. The arrangement of courses between this door and those capped by Bronze shows that Olive was the later master, which modified the team order to Jade-Bronze-Olive-Rose.

Delaporte thought that this flashing strip was a construction joint, indicating an oblique break in the

[16] The heights of nearly all his doors are 6^{TF}, with the corbel either dividing the space as $\sqrt{2}:\sqrt{3}$ or to a fixed dimension of $TF:\varphi$. This is a new way of handling the corbel and may show a new influence working on the crew though his men are still permitted the same individuality in carving them as before - II:18. Dated 1222. This is why I would date the town doors in the Cellier de Loëns and at 10 Rue de Cardinal Pie to this period, if not later. By the late '30's the shape had changed again to a standard half foot or so. See further discussion in n.27/c and XX:42/a.

[17] Elevated in n.14.

[18] See similar scheme for angled flashing which had been begun by Rose's relative Ruby in the SE(t) room - XIII:17/h.

[19] Delaporte 1959, p.317 and his plate VI. If they had decided to finish the north transept without towers they would not have built vaults in the end rooms, but would have continued the pitched roof from the inner rooms. The fact that Bronze's springing block lies below the flashing stone shows that towers were intended from the beginning of the rooms.

[20] Left side, n.14.

[21] See XIII:32.

[22] *Elevation of the east wall of the NE room from outside.*
The elevation is taken through the arcade and includes part of the north wall in the right. Read this drawing in conjunction with the exterior elevation n.27, and the section n.14.

a. Cornice and paving n.10. It is higher than the room floor level.
b. The bend in the wall shifts from course to course. The way the stones relate at the bend shows the order of work. The theoretical location of the bend from the plan is shown dotted!
c. The order of the placement of the stones in the corner, combined with 'b' and n.10/c suggests that the hatched area was finished by Cobalt-S.

JADE-b, 1221

d. The worn edges to the stones suggest that this was the lower entry point for materials.

BRONZE-c, 1222

e. Position of room vault springing on the other side of the wall. There is a butt joint against the older parts of the wall.
f. The point of access was moved to the left so that the corner buttress could be built.

OLIVE-d, 1223

g. Two putlock holes put in while he was filling in this access, and was moving the planking over the butress. Olive's holes often lie over the top of the stones.
h. Began the window - n.23.

ROSE-e, 1224

i. Continued the window with his corbels, flashing etc.

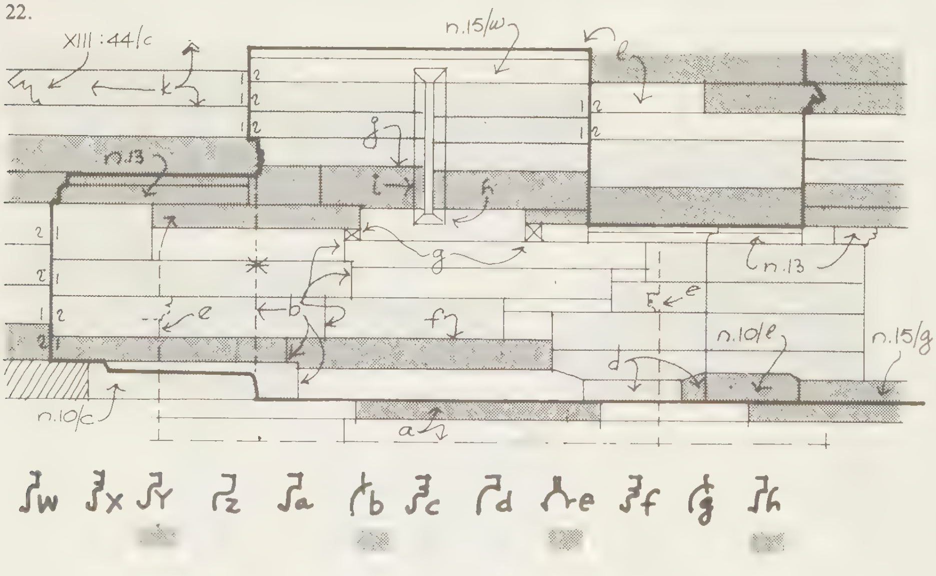
BRONZE-f, 1225

j. Altered the window plan in n.23.
k. Raised the wall as a pier to support the flyer buttress, and placed the cornice. See extent in n.27.

RUBY-h, 1227

l. Laid the soffit over the passage with the cornice over corner buttress n.36 and 37.

22.

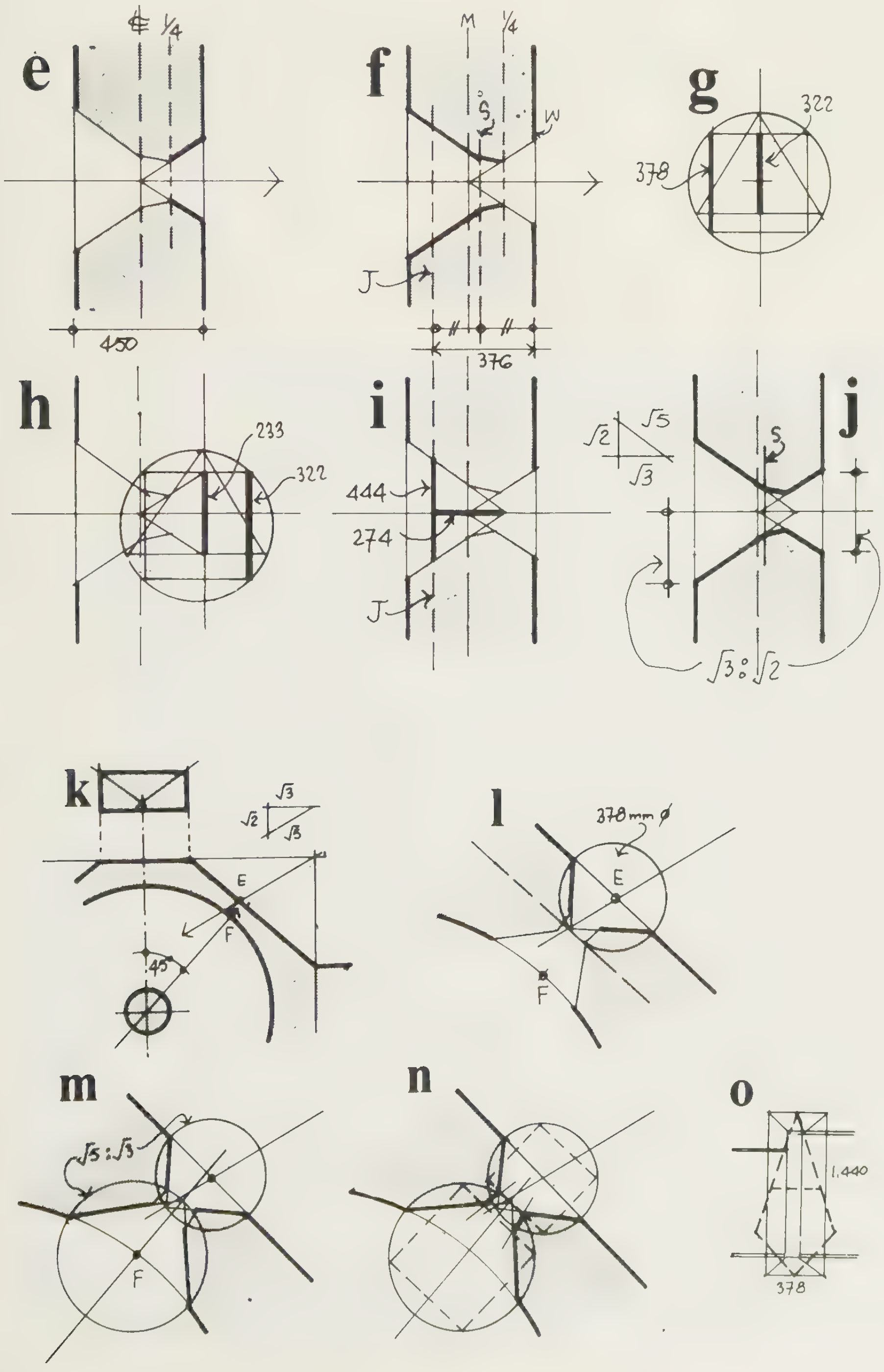


[23] The geometry of the NE-E window begins from the middle of the room, the line from which fixes the window **e**. The outside splays meet at the centre of the wall, and the sides of the slot meet the splays at the quarter line. I applied the same thinking to the inside corners of the slot S in **f**, and on doubling WS to J obtained a distance of 378mm from J to the outside of the wall W.

work.[19] While it is always pleasant to find other people looking for breaks too, this is not one, for in the NE there is a Rose corbel on *both* sides of this stone. There is the one over the door into the roof, and there is another on the outside of its eastern wall. You can follow the coursing in the section to see that both corbels are in the same course.[20]

The outside one lies over the passage which passes through the NE.II buttress. The coursing along the eastern wall is extremely uneven, for the way the stones are laid suggests that they could not get a free access to it. It seems to have been dictated by the location of the crane alongside the EN tower.[21] There would have been horizontal gangways which led from the crane into the north transept through this wall. Materials were moved along it into the rooms, and as the walls rose the planks would be raised too. But because they were there they tended to get in the way and made it difficult to lay the stones for their wall. It is like a Chinese puzzle, which has been amusing to solve. See the elevation at the bottom of the page for its story.[22]

There is a window in the middle of this wall which has a plan superficially like Bronze's, except that the sides of the slot are not parallel, but are angled to one another.[23] There is another one just like it out of the NE stair,[24] and by analysing the geometry of both we can see it is the



This relates to his foot by the Alchemist's figure **g** and remember this is the figure he used in the crossing - GEOM:VIII-A. The same figure relates his foot to the outside splays **h**. Now, on the inside the width of the splays along the line J turns out to be another in this series, as is the 274mm height of the triangle.

The series includes these dimensions: 444, 378, 322, 274 and 233. The middle one is the foot. All of them have now been used in the window except for the foot itself.

There is an alternative which brings this window in line with NE.64 in the next note. The inside triangle is either the one in **i** or a √5:√3:√2 ratio, and the proportion of the window opening is √3:√2 in **j**. They are only relationships, and do not explain the location of the line S, nor the sizes used.

24. The geometry of the window out of the stairs, NE.84, stems from the 'box' which surrounds the buttress **k**. This box is an adaptation of the one used by Olive in the southern buttresses in GEOM:XIII-B. From the corner draw a line suiting a √2:√3:√5 triangle to pinpoint the centre of the external splays E. To locate E he drew the line from the newell at 45° to its thrust line. In all his work we can see that he was obsessed by those angles which unified like things - as in the Alchemist's figure which joins the square, the triangle and the circle, and in this triangle which unites the first three roots. The second move **l** is to fix the centre of the wall, and to draw the circle against it. Notice that the diameter of this circle is one of the series in the previous note. Along the axis through E draw the outside splays. He made the inside circle **m** in proportion to the outside one as √5:√3, and placed the splays in the same way.

Having just used √5 and √3 he seems to have looked for a way to use √2 as well. So in **n** he created the splayed sides of the central slot from the squares within the two circles, for the corners between the slot and the triangles come from the intersection of the squares with the triangles. Not only has he made his window from the three roots but, as in the Alchemist's figure, he has used all three geometric shapes of circle, triangle and square.

The vertical proportions were completed by Rose as 1:3 on the inside and the pentagon star, or 1:1+φ, on the outside **o**.

work of Olive in 1223. The shape of the NE room window was changed in the third course,[25] pinpointing the next joint. It is the work of a later Bronze whose work can be followed right round the job.[26]

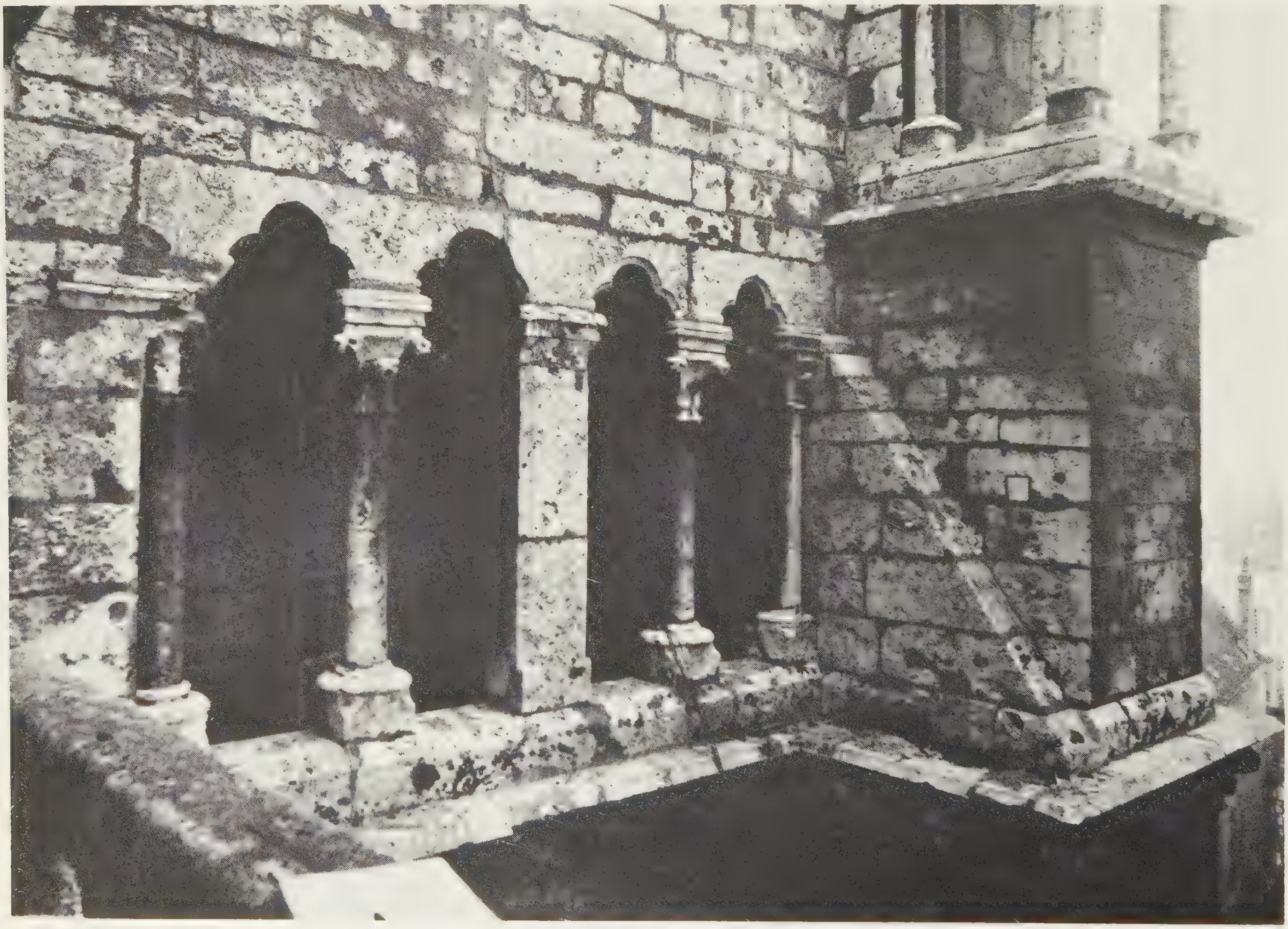
The eastern wall of the NE room forms the inside of the passage which passes over the triforium walkway. It is enclosed on the outside with an arcade.[27] Bronze's change to the window coincides with the large block of stone Z to the left of the arches. It sits over the impost of the column, and was built before the arches - because it is higher than the arches, and because there is a packer marked between the impost and the arch. The arches are therefore after this large block.

Notice their shape: the arches are three-foil, they finish with either a square cut or a ballmould, and their joints are arranged to suit the sizes of the stones as they came from the quarry rather than to suit a structural logic. They are identical to the ones over the thin colonnettes of the south front, and so are the work of Jade following after Bronze in 1226.[28]

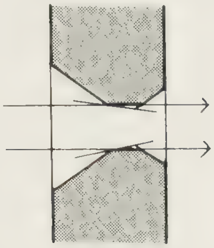
There are many broken courses in the wall over the arches and alongside the buttress on the left. They are marked L on the elevation, and show that they had been building the buttress at a much faster rate than the rest of the wall. The reason was that the choir vault was now so advanced that they had to be able to support the end of the flyer arch shown at the top of the drawing before the vaults could be finished. The cornice and plinths of the tower are just jammed against both sides of this buttress showing how separate it is. Doesn't this show how the builders were still having to solve complex constructional problems stemming from the delays to the north porch twenty years before?

On the other side of the transept there is another window looking out of the west side of the NW room. It is a Bronze window, and like Olive's on the other side its shape changes just above the sill. This is Bronze-c, and the change in shape coincides with the Olive corbels from

PHOTO 410: The eastern passage arcade discussed in n.27. The buttress to the right has been narrowed for the aedicule. The curious location of the joints in the arches is obvious.



25. Bronze made the sides of the slot in Olive's NE-E window parallel. See also in note 29, where he does the same.



26. n.22/j and on the inside n.15/w and over the north door. It coincides with his corbels over the NE-t door.

27. *Elevation of the eastern passage, and both 'arcades'.*

a. EN.II sanctuary window, arch and corbel by Ruby-M to Bronze-O - X:43. Follow the vertical joints to the north.

b. The southern head over the NE.III window is like Bronze-O, placed after the arches over the sanctuary window. The one on the north probably by another crew, though could be by Bronze with the vaults of the aisle inside - XI:24. The voussoires over this window and the southern part of the wall could have been erected by Scarlet-P to the cornice by Ruby-R.

c. 'Arcade' arches by Bronze-X and Scarlet-Y - n.5. The arches on the west may be replacements? On the east leaves by *Horn* are set into spandrels like the vestment patterns on the Confessor in S.eR1 - XVI:**E**7. The roll-moulds rise out of square bases like the imposts in the N(t) rooms - n.14/h. These arches are not like the ones Bronze used over the south porch, nor are they like the ones he was using over the south colonnettes in the same campaign. Is this another indication of a change in crew leadership? If the new master was trained by his predecessor there would not necessarily be an immediate and total change in the crew's style. It would tend to be gradual and piecemeal. So over the south colonnettes he could have continued with his older simpler section to match Jade's on the east side, while here over the north experimenting with a more decorative arrangement. Any influence from the *jubé* - XVI:40?

COBALT-Z, 1219

d. Leaves over the arches Scarlet-Y and Cobalt-*Clover,* sharply edged and undercut - XV:24/III and n.6 and 7.

e. The stone with the moulding over the arches is set deeply into the buttress. Follow the joints across the north front in XV:37.

f. He reduced the depth of the upper 'arcade' so no statues could have been placed here. It is tied in with the adjoining eastern leg of the buttress because two of the courses in the buttress extend over 'e'.

OLIVE-d, 1223

g. Laid upper 'arcade' bases with his cut corners.

h. Laid 2 bases to the eastern passage with the buttresses. One on the north had a leaf carved into the splay by *Spout*. Similar bases in n.15.

i. Caps with leaves contained within the impost form. Note the putlock holes shown crossed, and his corbels above them.

ROSE-e, 1224

j. Cap by *Cup* in a 365mm stone laid with his corbels. He works to a 2:1 proportion across the opening measured through the centre of the shafts. Compare to 'm'.

BRONZE-f, 1225

k. The upper 'arcade' arches - n.5. The splayed corbel on the inside is like the ones he used over the SE-E(t) passage in XIII:3/u, and under the sacristy bridge in VI:22/r.

l. Pushed up the SE corner to support the last arch from the choir flyers. The vertical joint is quite clear on the north side, with another stepped joint across the wall. The vertical joint continues past the moulding under the tower piers. XVIII:73/b.

JADE-g, 1226

m. His caps, as in the triforium passage, are cut from 422mm stones - n.32. The impost was raised 130mm over 'j' to alter the geometry of the opening to **p**.

n. The central post is square with splayed sides finished with square endings as in his arches. He must have been following the arrangement used in the south - XIII:18.

o. Packer stone - n.14/t.

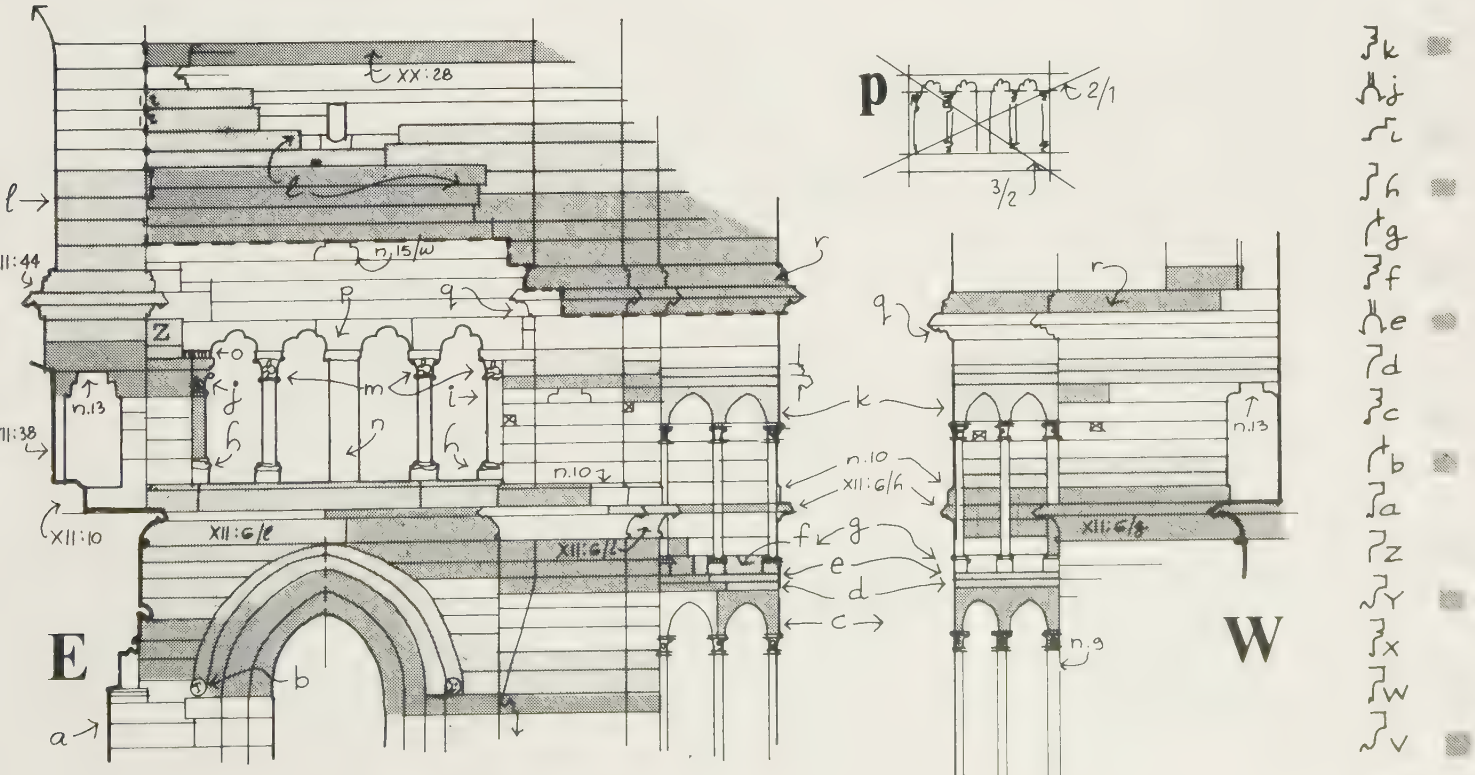
p. Arches like the ones he installed in the south, square cut ends and ball mouldings, irregular joints - XIII:62.

q. Started the cornice under the north-east corner to support aedicules, and all of the north west. For different heights see n.36. With the nw. he began the arch over the west wall - n.14/u., the dotted line shows that tilt in the work at the end of this campaign.

RUBY-h, 1227

r. The rest of the cornice and the moulding over - n.36.

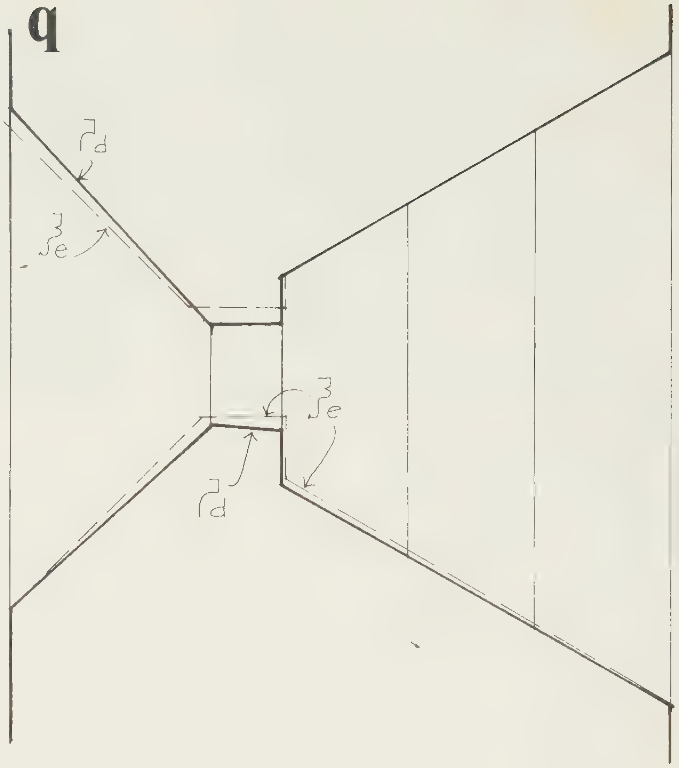
28. Arches - XIII:62, evidence for Jade in 1226 - n.11.



the room into the roof.[29] If you follow the courses on the outside you will see it coincides with another alteration - to that of the arch over the southern side of the room[30] - showing that the changes in the east are matched with just as many in the west.

Return to the east and look at the exterior elevation.[27] Olive's coursing coincides with the top of the upper row of arches of the 'arcades'. We can now return to the questions and clues mentioned at the beginning of this chapter. These arches could only have been carved by Olive, Rose or his successor Bronze. But neither Olive nor Rose could have carved the similar arches to the lower arcade because they were not working on the job at that time. Bronze is the right choice, confirmed as the leaves in the spandrels are by *Horn*. He arched the lower part in 1217 at the same time as he was carving the door onto the porch roof, and again in 1225 when he was carving another set of corbels over the doors from the triforium into the stairs.

The drawing[27] shows how each part of the 'arcade' can be locked into the stonework above and below the triforium walkway. All the details seem to fit logically into the work of the known crews, and we can now see who thought of building an arcade, who modified it and how, who added the second storey, and who finished it off. Though this does not explain why it was not carried



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29. As can be seen in n.14 the interior splays to this window, NW.III-W, were begun by Bronze. The plan would probably have been the same as the contemporary window in XVIII:35. The outer splays and the slot were determined in the sill, by Olive-d, but in the next course was altered again, by Bronze on his return in his next campaign 'g'. Olive's outline is shown solid in **q**, while Bronze-f's is dotted.

The joints may be followed from the NW-W door corbels, to where it drops at the room vault spring to a lower level along the west wall - n.14. On the other side of the south wall the joint can again be followed from Olive's corbels over NW-S, via a bulbous corbel underneath the NW.II roof space, to the outside where there are two more Olive corbels over the passage through the NW.II buttress - drawn in n.30.

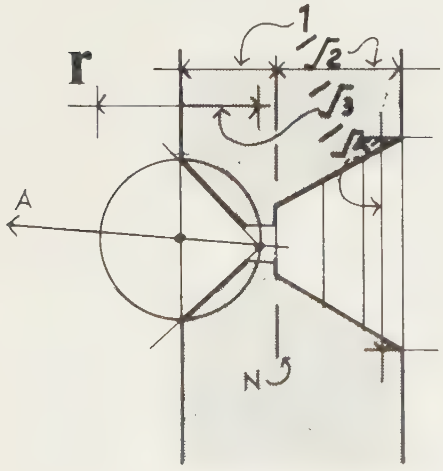
The inside splays had to be accepted by Olive, so in **r** he used a cluster of roots to proportion the circle which forms the outside splays and the inner face of the slot N. These roots began with the inside opening, as $\sqrt{5}$. The exterior triangle was offset to point to the centre of the gap between the buttresses.

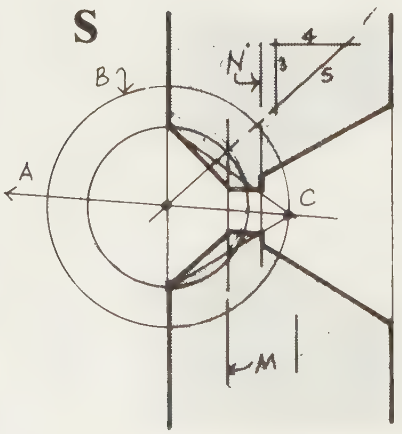
In **s** the outer corners of the slot were located on the intersection of the outer triangle and a line M set at an angle of 3:4:5. Again he used clusters of numbers. The internal corners of the slot were fixed from where the circle marked B (which is $\sqrt{2}$ times the circle forming the outer splays) meets the A axis at C, and C is then joined to the outer corners of the window.

If you compare this to Olive's other two windows you will see that where he has had to compromise with an existing interior his method is freer and less disciplined than where every part of the window is his. Nevertheless, the elements from which the window will be made are constant: numbers of 3,4,5 are used, either as integers or as roots, and the triangle, the square and the circle. The foot turns up once, and the planes will be twisted to align the window with structural centres. The window is thus an intermediary between elements, evolved from some, and then modified to include the others. By creating a link between parts that are not in harmony the window re-establishes unity.

Bronze kept the inside face where it was, straightened and centred the slot, and to some extent regularised the external splays, as he had over the NE-E window in n.23 and 25, and not unlike his action against the bent axis in 1195.

Do these changes show that the master examined every templet and altered what he could, or that the foreman, knowing his bosses preferences, made this sort of decision for him? The continuation of work already begun should have been automatic, for the master could have just instructed his carpenters to go round the job and cut the templets needed from the built work. However it did not work like that, for there are constant changes in repetitive work, which imply a standing instruction to the foremen that the master was to be called in on every shape which was not walling, buttress or pier - or that he methodically examined every bit of the work personally before allowing any work to proceed.





out over the porch, we can at least see who was going to do it.

At the same time the central buttresses were being built, with openings through them over the walkway. The inside part was built first, and after the corbel over the opening was put in, the outer part was built as a pier to support the full shape of the buttress overhead, as you can see in PHOTO:355. In 1223 Olive had put his corbel on the inside.[31] It is next to his window from the NE stairs. The opposite corbel over the pier looks like an Olive, but is a Rose: like the others we studied in the southern towers the bottom rollmould has been buried in the masonry, and for the same reasons. Though carved by Rose it was placed by that inveterate plagiariser, Jade. Above the corbels the shape of the buttress was altered a number of times, showing we should look for a couple of additional crews in here. If we follow the courses in one direction through the nearby lancets into the triforium arcade, and in the other to the rooms themselves we can

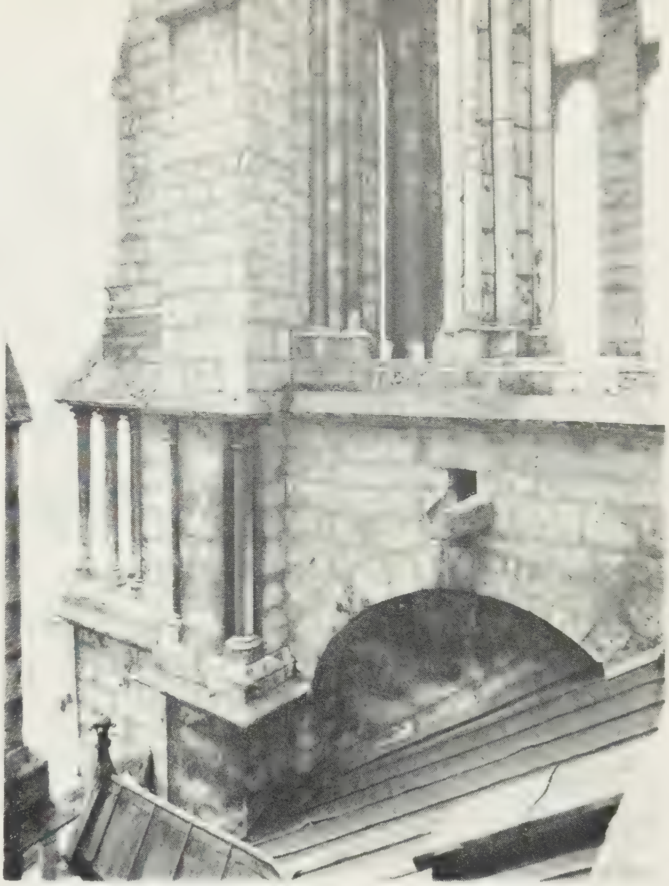


PHOTO 413: The NW tower seen from the south, being the same as the drawing in n.30. The inclined flashing course is clearly visible, as are the aedicules discussed at the end of the chapter.

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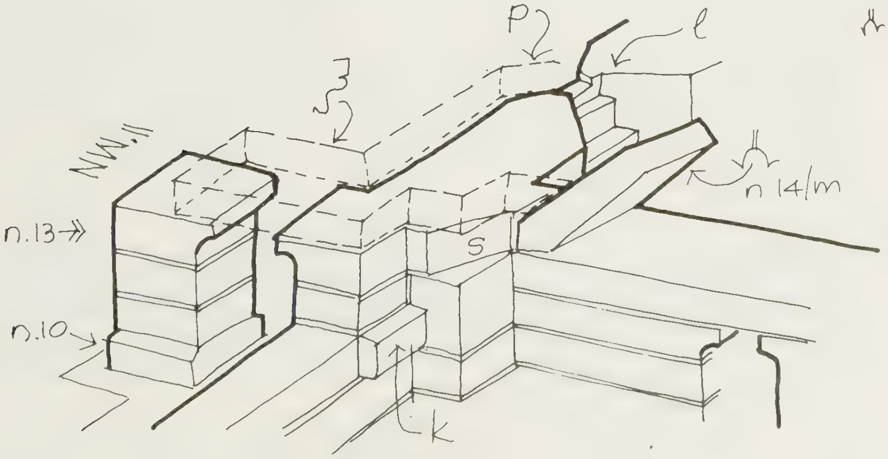
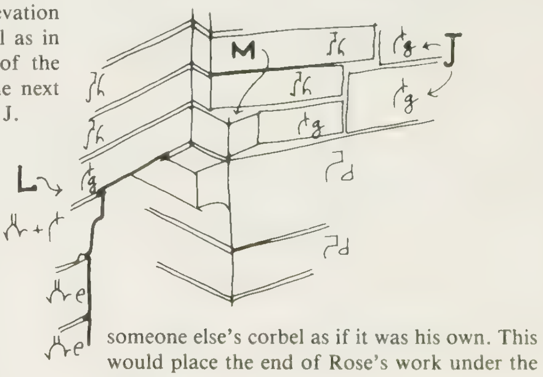
30. This is the NW.II room under the roof, the south side of the corner 'k' in n.14. The references on the drawing are to that note. Notice Olive's corbel under the roof plate, and how it links up with his outside. Rose built the flashing strip 'm' and changed the shape of the arch with the splay 's'. Bronze's course over that is dotted and includes squaring up the arch, and changing the NW-W window 'p' as in the last note.



31. N.c-e passage drawn from the west side. This is marked on n.10. There are obvious changes around here, but by whom? Start with what we now know. Olive's corbel was laid with his window NE.84. He slightly widened the buttress. This is confirmed in the elevation of the triforium arcade in n.32, as well as in what has gone before. The progress of the arches over the triforium show that the next courses must be Jade. They are marked J.

Now consider the pier on the left begun by Rose with his corbel on top - but as the corbel was pushed into the wall to make it look like a Jade, I have assumed he did the same here as he did in the SE(cw), in XIV:29, which was to lay someone else's corbel as if it was his own. This would place the end of Rose's work under the corbel.



Working down from the cornices above -n.36 - the large stone under the cornice must be Ruby as the corner is altered at M. Hence the projecting squared corner and the lintel over the passage must be Jade, marked L.

If Jade had not misplaced the Rose corbel it would have divided the width of the passage into three, one part to each corbel and one to the space in between with a height to width of 1: √3.

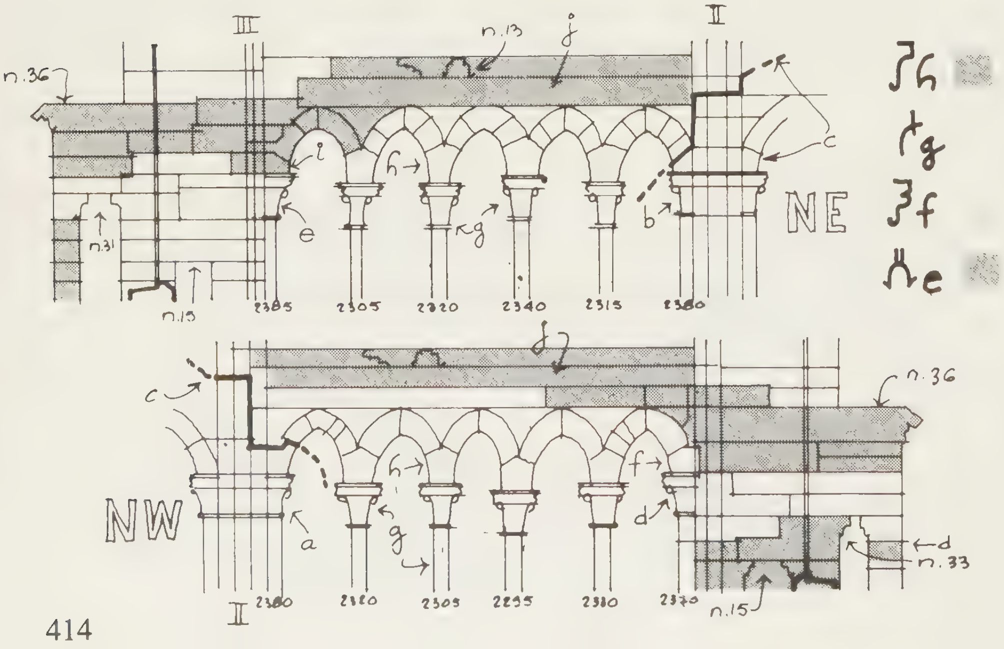
identify them.[32]

The situation is similar on the western side of the lancets, but the inside corbel is Rose's, and by analysing the plinths[33] it would seem that Rose placed his corbel at the same time as he was laying the plinth under its pier - if only because the widths match. However his successor Bronze-f then reduced the pier, and it was not completed until the next year when Jade-g finished it off with his corbel. We do not have many of his on the job, and this one shows it to be a smaller version of Olive's.[34]

In earlier parts of the building it has not been necessary to illustrate the walls so profusely, for few other parts of the building were built so slowly. Also, this type of analysis demands a certain amount of understanding and agreement from the reader. In the past historians have ascribed these little changes to poor workmanship, lazy supervision or later reconstruction. We have had to be convinced from the earlier chapters that this is not so, and that each stone was a precise statement of the intentions of the master who ordered it. To say less is to deny not only his authority, but his skill and ability. Now this is established I felt I could build large conclusions on small differences without prompting your scepticism.

The slow pace in the north is in contrast to the rapid work being done elsewhere, for in the eight years from Cobalt's work on the NW.64 window to Jade's conversion of Rose's corbel, all the flyers to the choir had been completed, with their walls and windows, the high vaults and the roof over them. An immense amount had been completed in the main body of the church, showing that most of the available funds had been diverted there, and that consequently the work in the north had to be limited to the odd jobs which could be given to gangs who could not for the moment be employed elsewhere.

But with Ruby in 1227 the choir was complete, and attention could swing back once more onto the transepts. In one campaign Ruby laid six or more courses, including the cornice under the northern aedicules. There is an important lesson here, for the cornices on the east side of the transept are 410mm higher than those in the west. Though the difference is absorbed across the space of the lancets where it is hardly noticeable, it had weighty consequences further up.[35] The differences were begun when Bronze laid the cornices at A as part of his hurried



32. *Elevation of both triforium arcades, N.III.* The extent of Jade's work is shown lightly shaded, and the adjoining bands of work, even where I am uncertain, are shown in other shading. For the parts outside the lancet windows note the references on the drawings.

a. The capital next to the NW.II pier is built with it by Scarlet-*Chops* in 1206 -XII:32/III to a height of 2,380mm. The arch with the projecting starter is probably Cobalt-S, for it is like the ones he laid around the N.c door - XV:40/h - and in the clerestory - XVIII:6.

b. On the other side the capital must be after Cobalt's plinth, possibly Red-T. The height is 2,380mm.

c. The adjoining arch was built with the bridge by Rose-U - XII:32/IV.f. The joint between the rest of the building and the delayed north is marked heavily.

BRONZE-f, 1225

d. NW.III capital *Bustle.* It is above and after the Rose-e corbel in the N.c-w walkway opening. Height is 2,375mm.

JADE-g, 1226

e. NE.III capital the same as n.27/m. It is lower than Olive's corbel outside. See the section n.15. The height is 2,385mm, and from 'g' the joint must be underneath. This is confirmed outside.

f. Voussoire carved with the impost and the bridge over 'd'. The bridge has a chamfered edge as in his arch over the outside of the NW-W wall - n.14/u.

g. The caps were laid with the arcade to an average height of 2,315mm, or 65mm less than the adjoining columns. The heights are marked under each column. His work is as uneven as his arches.

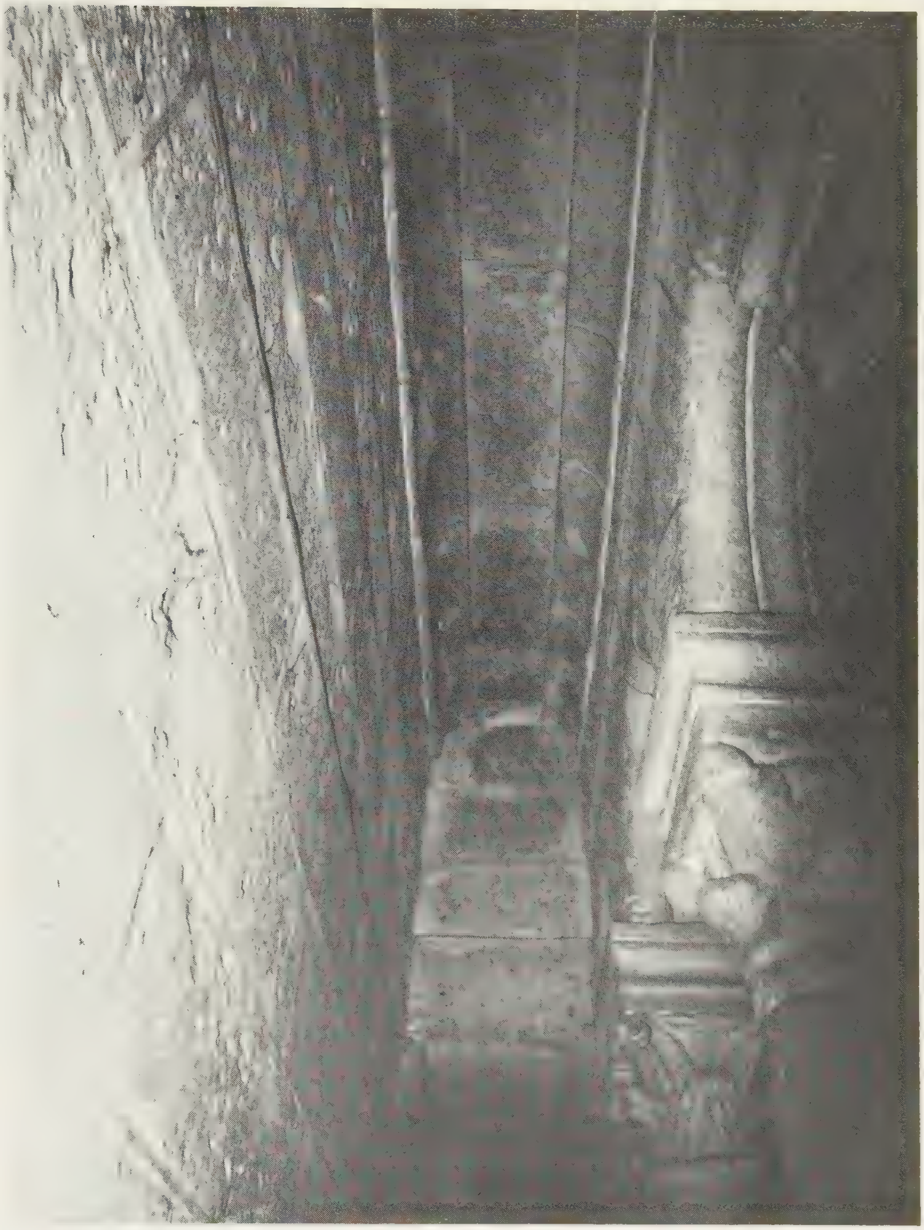
h. The starters for the arches vary in height as do the sizes of his voussoires.

RUBY-h, 1227

i. Built the NE.III bridge and finished the last arch. The bridge has no chamfer like his other in the nave - XIII:32. See section n.15. From this I determined the extent of his work in n.31.

j. Built corbels over the passage, and did the room vaults at the same time - n.14. We can tie his work in with the outside cornices in n.36.

PHOTO 415: The ceiling over the passage of the end bay of the northern transept triforium.



33. *Elevation of the north walkway outside the NW room, as seen from north.*

JADE-b, 1221
- a. Cornice and set-out of room with diamonds in GEOM:XVII-B.
- b. Plinth discussed in n.10/n. The change in the angle of the wall over shows the joint.

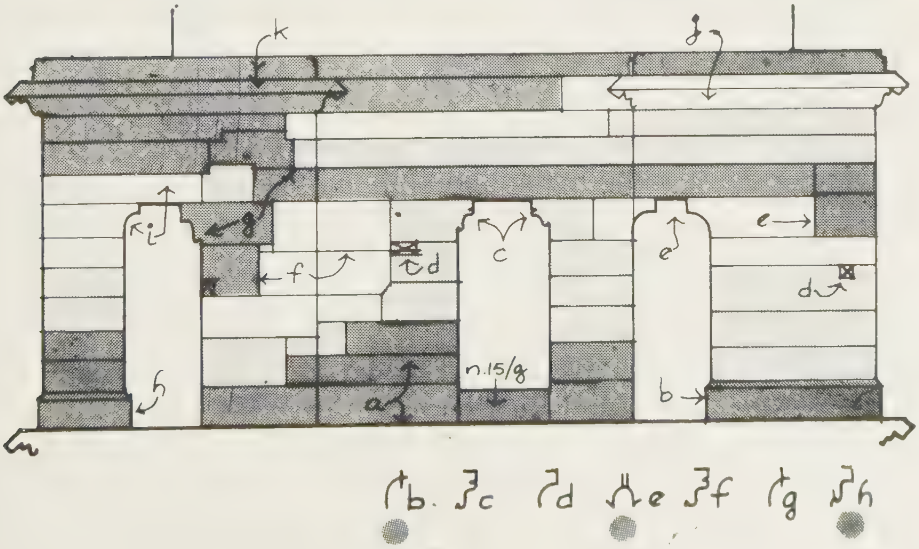
BRONZE-C, 1222
- c. Corbels as in n.13.
- d. Putlock holes and coursing shows how the door and the wall around it was much higher than the buttresses, particularly the one round the stairs.

OLIVE-d, 1223
- e. Corbels and part of buttress to the joint at changed coursing height to the right.
- f. Filled in around the stairs and in the NE stair began the window. Notice putlock hole.

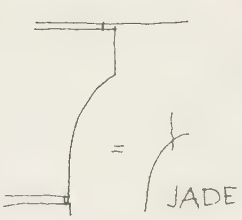
ROSE-e, 1224
- g. Corbel. Attribution of adjoining courses worked out from the different coursing sizes, see also n.32.
- h. Plinth in n.10/v & XII:10.

JADE-g, 1226
- i. Corbel to the outside of the passage and probably the course over that.
- j. Cornice under aedicule on the west, over the courses which are probably by Bronze.

RUBY-h, 1227
- k. Rest of aedicule as in n.36, a larger campaign as the choir vaults were now complete.



34.



35. The height of each tower is the same, and so the roof of the NW tower finished 350mm above that of the NE, and presumably this would have been continued into the next storey. It shows that heights were calculated as increments of what had been built before, and as in the northern pier footings in VII:24, once a variation had been begun it would inevitably be continued to the top.

campaign to push ahead with the NE corner buttress for his flyer, and in the same campaign when he laid the cornice on the other side at F.[36]

At A he placed it level with the cornices in the choir, and at F with those in the nave. The difference between the two is, on average, 420mm. Bronze perpetuated that difference, but why? Remember that the sacristy had not been built at that time and both were equally exposed, though I would not think that it would have been in their training to fudge a problem just because one side was hidden.

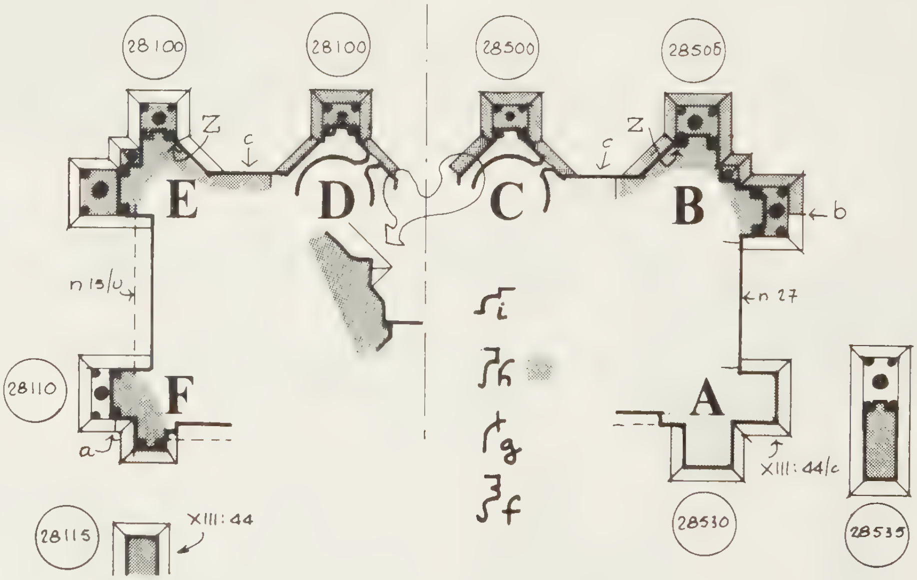
He may not have noticed the difference, but he had been on the job many times before and should have had some awareness of this problem. He may have intended to omit the cornices on the north, and to treat the elevation in an entirely different manner as was done in the south. However, the next master, the newcomer Jade, continued the heights begun by Bronze and began the moulding over the cornices which presage the aedicules above. Ruby then began the walls over B,E and F, and laid out these aedicules with a large central shaft surrounded by smaller ones.[37] Then in 1228 Geen, in his first appearance on the job, built the two windows over C and D, and with them began a new design for the aedicules. He removed the heavy central shaft, and replaced it with a thinner one, making all shafts the same size.

Once the cornices had been laid at different levels, their heights were not progressively adjusted on the way up. Apparently, these differences had to be continued to the very end. They were, in fact, never to be equalised, not even in the topmost cornice which runs around the roof which shows that they designed their verticals not as proportions of what had gone before, but as modular units extracted from it.[38] The decision to continue the aedicular scheme of the choir into the north was a momentous one, for they were then forced to raise the height of the parapet under the towers, which completely altered the appearance of this facade. The old fashioned look of the last towers to be built seems to have been forced on them because this master, new to the job, had decided to continue along the north front the elements of the choir. As the south shows, he need not have done so, for there the difference between the cornices of the nave and the choir is even greater than in the north,[39] and the colonnetted scheme obliterates it by eliminating the cornice from this level altogether. Jade could have followed suit, but did not. Was it because he did not realise the implications? Is this another of the many hints we have that there was no master plan, but only a model or generalised concept within which the masters made *ad hoc* decision as required?

For the fifteen years it took to build the rooms under all six towers, the south and east as well as these in the north, every master was working towards a three-storey cathedral form with flyers and glazed clerestory, with stone vaulting and a girdle of towers. This much was common to all masters. But the details, the dimensions and the structural techniques differed from crew to crew.

The more I know of this building the more difficulty I have in persuading myself that there was a master scheme of more than the most generalised kind, let alone one single master mind behind the day-to-day design of the cathedral.

From chapter XII onwards, with the exception of the last one on sculpture, I have examined the one zone of the triforium in which every crew from Olive-Q to Jade-g has left something. I am, of course, not certain about every



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36. This is the plan of the northern cornices and plinths under the aedicules. The RL's are given in circles. The changes in masters are indicated in the F cornice by the outer stones which were pulled out to widen the buttress 'a', and in B by the differences in the size of the drip at 'b'. The position of the joints at 'c' are uncertain, but the windows out of the stairs are certainly Green - XX:8 - as is the changed aedicular plan. Ruby's aedicules are deeper, and the inner shafts are set behind the corner of the cornice 'z', while Green's are shallower, and the shafts are set forwards.

37. Cornice must be Ruby from the corbels over the (t) passage - n.13 and 14 - from his bridge - n.32/i - and the changes discussed in other notes. His layout for the aedicules exactly notes. His layout for the aedicules exactly match those he began with the choir, and they have the same type of bases - XIII:47.

38. This can be seen in later geometries. The first instance is to be found as early as the footings in the nave - VII:24.

39. 28,110-150 in the south nave and 28,590-610 in the choir. Difference of 470mm average.

detail of the attributions I have made, but they are as correct as my patience and ingenuity can make. Any major alteration in the order of the masters could affect a number of attributions of detail - as for example those of the north 'arcades' or some parts of the triforium passage - but no amount of juggling (and I have tried everything I could think of over the years) can fit the northern crews ahead of the southern, nor the clerestory of the choir ahead of the nave.

By working on the triforium in such patient detail I have established the order of the crews with some certainty. In the next chapter I shall show how perfectly it fits into the clerestory. The fifteen crews who laid only a course or two in the rooms laid four or five times as much in the clerestory. They raised the inner walls from the plinths of the triforium to the topmost cornices, built the vaults and the flyers which supported them, set up the roof trusses and covered them in heavy sheets of lead, they rendered the cells of the vaults, and finally removed all the scaffolding from the main vessel of the cathedral. That was some achievement.

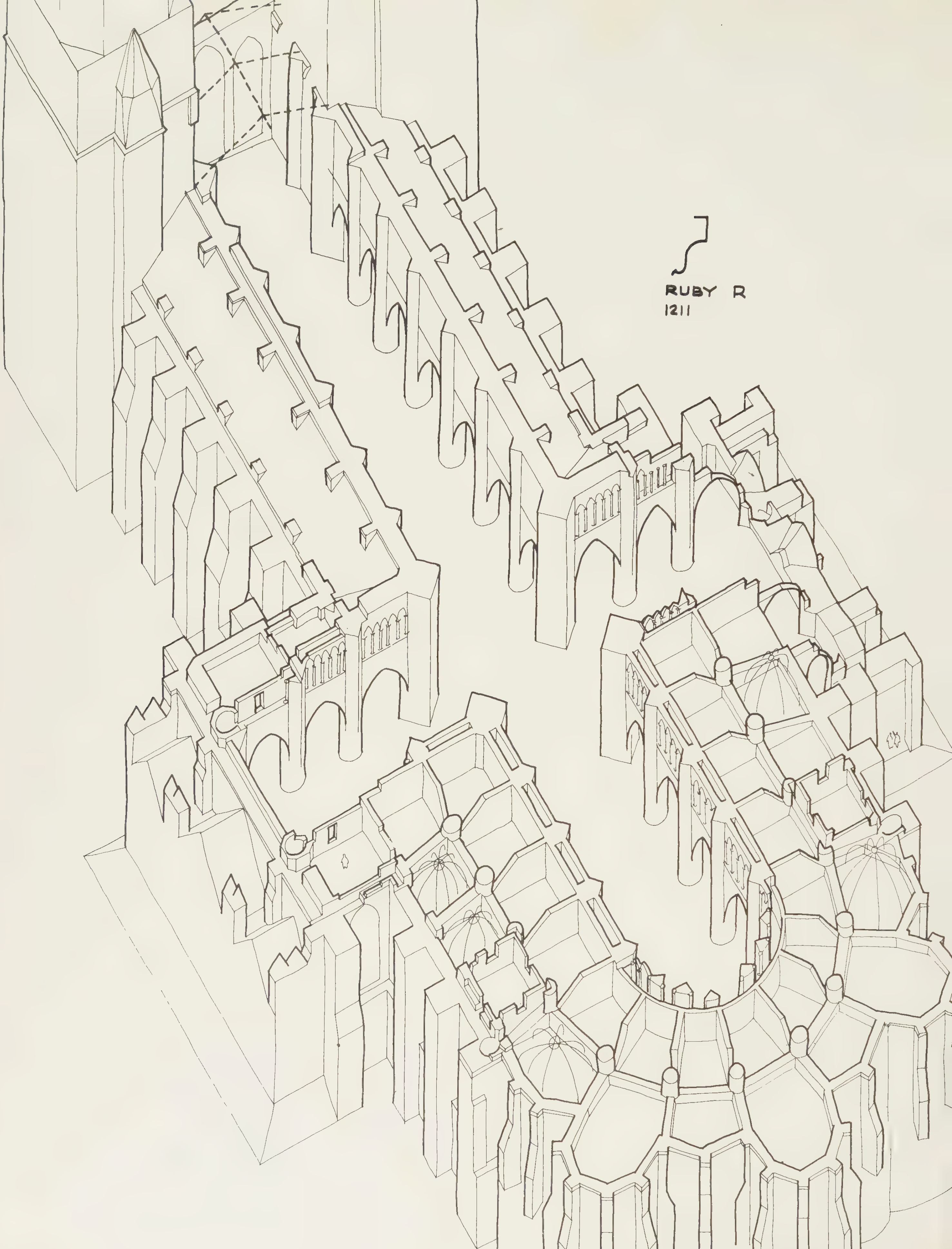
Difficult and slow as their work may have been in the rooms studied in the last chapters, these fifteen masters had put up over twenty meters of stonework under the most difficult conditions. The walls of the clerestory are high in the air, with fragile arches stretched over their wooden formwork across the spaces of the aisles and nave. They were vaulting larger areas at a greater height than ever before. They were battling with the forces of the wind, hail and snow to complete a totally experimental building unlike anything yet attempted. Perhaps with relief we can now escape from the horizontal walkways that encircle the base of the cathedral and move up into the soaring ecstasy of the flying buttresses.

ISOMETRICS.

The third set of isometrics from R to Z follow. Between Ruby in 1211 and Cobalt in 1219 most of the nave clerestory walls were completed and the different pattern for the choir flyers firmly established.

RUBY-R 1211

XVIII:9 XVIII:10,11,12,21 XVIII:61	If my surmise is correct, Ruby won the competition for the new clerestory design, and began the walkway in the nave, the sills at the western end, and started the mullions.
G.XVIII-B,C,F XII:32/IV XII:31	He capped off the top of the triforium arcade, leaving his corbels to signify his presence there. This also fixed the height of the string course above the floor, as well as the walkway and the sill. This firmly secured his proportional system into the central triforium zone of the cathedral, using the crypt module


RUBY R
1211

externally (which was equal to one third of 100^{EF}), and the sqence of squares internally.

Note the large amount of work that has been done to the interior walls of the nave clerestory and the choir triforium, while almost nothing has been laid around the perimeter. Without the plinths to the triforium walkway this passage has been left unobstructed, presumably for the scaffolding, that gave access from the crane along the entire length of the nave. Though this is not one of the largest campaigns, he laid as many as five courses around the interior, and seldom more than two elsewhere.

II:26

I have shown him finishing the roof over the triforium, though this is the earliest it could be done. Either Ruby or Olive laid the inclined stones over the cross walls under this roof to eliminate the gaps that exist in the east.

The inner part of the perimeter buttresses project through the roof, having been progressively raised, perhaps to the underside of the corbels over the walkway. It is indicative of the slowness of this part that these corbels were not to be laid for another three campaigns.

II:11
XVIII:31,64

With the clerestory sills Ruby could have begun the temporary roof over the nave. It may have been supported on the great beams that were intended for the main roof, giving the timber time to dry before being installed. The construction would have been massive if the roof was to be used to support scaffolding.

XIX:33
XI:2

At the west the walls of the two twelfth century towers step in, and to close this gap Ruby continued the corbels Olive had begun, for the support of a wall in front of the towers in line with the rest of the nave. Both masters used their own type of corbel. At the same time he was cleaning up the last remains of the join between the destroyed twelfth century nave and the towers.

XVIII:30
XIII:17,37
XII:38,41,42
XII:6

In the choir he completed the filling over the apse vaults, providing a level platform for the men, probably shedding the water down the holes through the centres of the the bosses. He laid a few courses in the eastern piers under the flyers with some corbels and continued with Olive's decision to do without any more stone roofs around the apse, building upstands over the cornice for steep-pitched wooden structures instead, and with them the remaining cornices. As in the high roof a dozen years later these delicate mouldings were left off until the heavier work nearby had been completed.

XII:32

Internally he installed the triforium arcade piers in the apse, a few of the capitals and the bridges over them with chamfered edges.

XIII:6
XII:6,41,42
XIII:38,43

As his work on the southern buttresses shows, he would have applied colonnettes around the buttresses above the level of the walkway. Given the opportunity I presume he would have continued them into the nave and the choir. In the EN.IV buttress he laid only a plinth, with the eastern door frames. Another couple of courses here and Chartres' south front may have been the norm, rather than the exception. To what a small paucity of funds do we owe the present un-colonnetted scheme!

G:XIX-B

Were these colonnettes just an aesthetic device to verticalise the building, and if so why do we never find them around the level of the aisles anywhere in France? Or do they relate to the symbolic nature of the upper zone as luminous and heavenly, in contrast to the lower as massive and earthly?

XIII:38,43
XIII:17
XII:41

After the amount that Olive had built around the rooms under the apsidal towers, Ruby did little here though he completed the drains, and was now ready to install the roofs over the sanctuary rooms.

XII:6
XIII:29-33

In the south he finished the cornice around the SW corner, though the SE was left for another two campaigns, presumably because of the nearby crane.

XIII:15
XIII:12
XIII:3,7,51
XIII:1,34
G:XIII-A

Above that he laid a few courses to the south transept wall with the doors from the rooms onto the walkway, the supports under the ribs in the SE room, the ribs themselves and a few treads and corbels. But not much, just enough in fact to clear the doorways from the circular stairs so that access for his men was improved.

XIII:17,18
XII:42
XIII:7

Around the eastern walkway of the SE tower, on the outer NE corner, he laid the base for a column, thus beginning the external arcade which screens this walkway. On the eastern side of the same buttress he began a projection for another screen instead of a wall in front of the room Bronze had begun. And in front of the apsidal room he set the walls in from the plinths for a screen here too, though he had to work from Olive's plinth rather than from a dado as outside the southern rooms.

G:XIII-A

He also began the inner splays for the SE-S window, aligning them on the ribs on the opposite side of the room. The absence of this window on the opposite side shows that Ruby's work in the west was lower.

XIII:7,11
XIX:32
XII:32
XIII:56

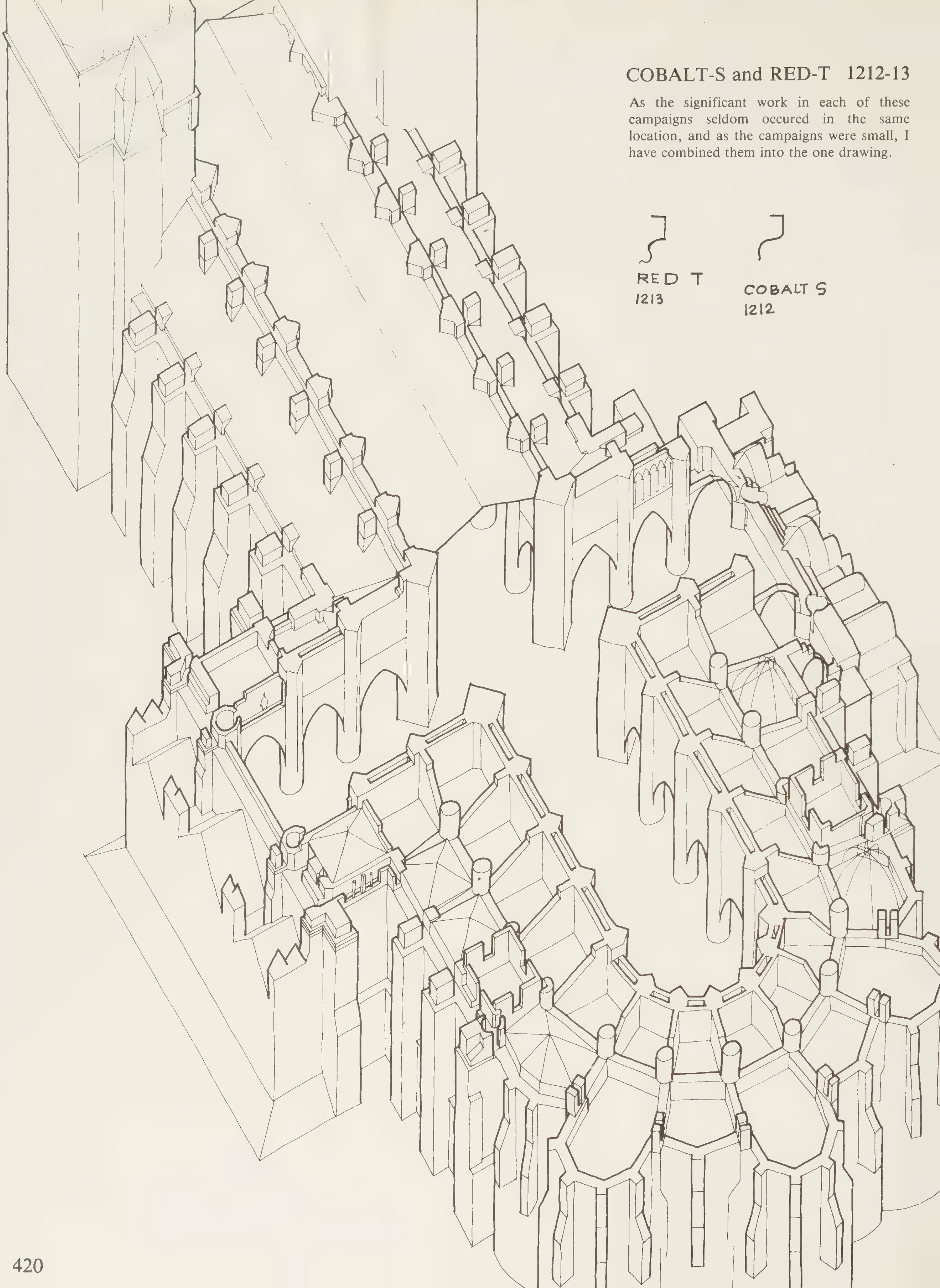
He laid the lintels over the southern gallery doors, and completed the sills. The bases in the sill supporting the attached colonnettes over the face of the lancet mullions are not from this time, but are later insertions. Inside Ruby also put down the plinths under the third bay of the triforium, with some columns in the adjoining bay, and half the bridge in SW.II. Ruby laid all six courses of this pier, from the torus to the bridge. On the opposite side he built a bridge over SE.I, and brought the NW.I triforium pier to the underside of the bridge with the capital.

XV:14,24,40
XVI:38

He did no work in the NW stair as he seems to have been concentrating on the centering for some of the lintels in the porch, and one of the ribs in the N.e porch. He carved one of the large blocks in the next course, west side, for a kings recess, and one piece of sculpture for the outer porch archivaults.

COBALT-S and RED-T 1212-13

As the significant work in each of these campaigns seldom occured in the same location, and as the campaigns were small, I have combined them into the one drawing.



XVIII:10,11,21,27-8 The rest of the clerestory plinths and sills were
XII:10,42 placed in the nave. They laid all the perimeter
G:XII-A,H plinths in the nave and in the sanctuary and the
apse - the double row of flyers slightly altering
the sizes compared to the simpler arrangement
XIII:6 in the nave. Ruby’s colonnetted scheme for the
nave was over-ruled, and plain unadorned
XVIII:22 buttresses were built instead. Cobalt realigned
G:XII-H his to point towards the centre of the buttress
on the opposite side.

By installing the buttresses on both levels of
the nave at the same time they would arrive at
XVIII:49 the supports for the flyer arch, both at the
springing and at the top, at the same moment.
An economical arrangement as work is only
being done when and where it is immediately
needed, and not for some future need.

II:11 The temporary roof over the nave would have
been completed, discharging its water over the
sills. So less than 20 years after the great fire
the work was advanced enough for the entire
nave to have been opened for worship under a
generous roof above the triforium.

XIX:33 The western wall was capped off over the
twelfth century pilasters, and the exterior
projecting figures carved over them. The base
line had now been established for the rose
window, which was to be Scarlet’s last great
masterpiece in the cathedral.

XII:10/h The E.IV buttresses were modified to present
the same face width, and the stair diameters
XIII:38 were reduced so they would fit inside the
smaller area.

In the southern rooms Cobalt’s work is more
XIII:1 obvious than Red’s save for one of the latter’s
corbels. He continued Ruby’s work in the
XIII:1,3,15 south walls, providing the external opening for
XII:6 the SE-S window, but making no move to
XIII:6,7,17,18 provide a matching one out of the SW room.
Two corbels in the SE, and the cornice in the
XII:10/II SE corner and the plinths over that for the
external arcade on the eastern side. It was
XIII:18 reduced in size by Red in the next SE.III
G:XIII-C course. They continued the colonnetted scheme
around the south, laid a few double treads in
XIII:51 the stairs, the plinths under the triforium
arcade and with Red some of the triforium
columns and caps, and the bridges in the
XII:10.32 transepts.

The two southern rooms had now been raised to about the same height, and over the next six campaigns almost nothing was done to these walls, save maybe one course a year. This suggests that the area was held back for some reason. I think they may have erected a temporary roof over these rooms, and used them for site offices. The location would have been convenient, situated right in the middle of the triforium zone central to all operations. A perfect tracing room.

XIII:43 Cobalt did a certain amount of work around
XII:32/III the choir, a few of the triforium capitals, and
XII:41; XIII,1 one corbel, with the arched coverings over the
drains. In the apse buttresses he did not
XII:42 continue the ‘Y’ drains of the sanctuary, but
XII:38,41 cut his drains through the length of the
buttress to a spout. Where the ‘Y’ had already
been laid the decision had been taken out of
XII:10 his hands, so here the plinths are like his in the
nave.

Cobalt began the starters for the springing of
XIII:43 the thick arches that encase the apsidal rooms,
intending to enlarge the outer part of the room
by almost 1½ meters.

Red on the other hand seems to have
concentrated his efforts on a few parts, doing
XIII:37,38,40,43 less on the triforium passage walls, and more
to the perimeter rooms, with up to seven
courses in the eastern stairs. There are dozens
XIII:1,36,43 of his corbels where he has finished piers,
buttresses, and particularly the walls around
the eastern tower rooms, with their windows.
He presumably raised these walls to secure the
XIII:29 scaffolding to the triforium. He carved the
XII:36,37,39 plate walls in front of the sanctuary rooms and
began their rebated roof slabs, at least in the
south.

Red seems to have spent much of his time in
XIII:38,41 three of the six stairs. By supporting his treads
on corbels he provided us with firm
connections between his work in the sanctuary
and the NW doorway. Because of the site
offices he did nothing in the southern stairs,
XV:8,15 and because of the temporary roof over the
XIV:9 N.e doorway, none in the NE stair. He carved
recesses on the underside of his lintels for door
swings.

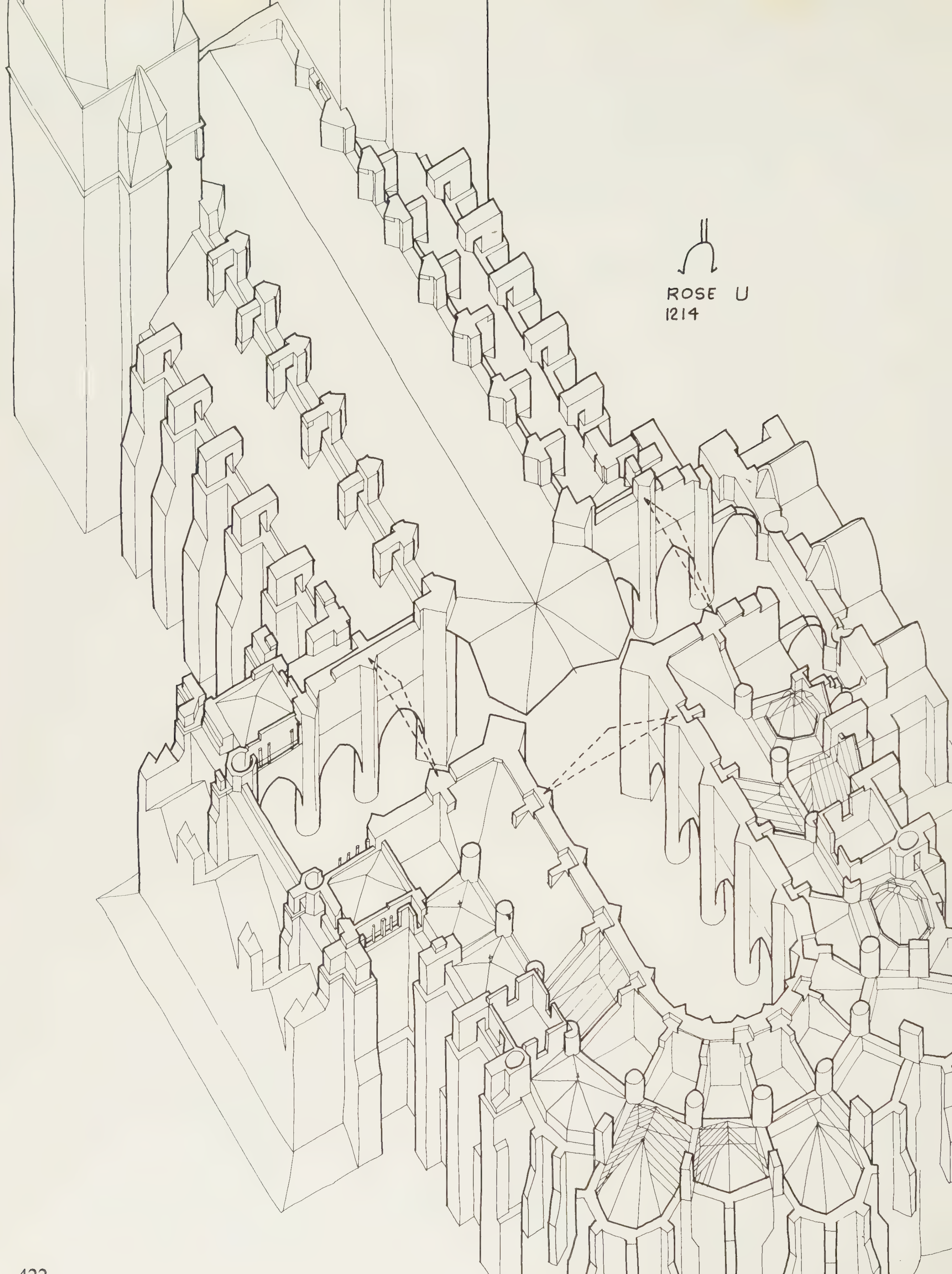
XVI:15,38 Cobalt had erected the last of the north porch
XV:12,24,38 piers, plus the sculpture and lintels they
support, and began the vaults over them. He
XVI:38 altered the shape of the ribs begun by Ruby,
XV:25 and started on the panels between them with
XVI:38 their bar-tracery patterns. Also some of the
outer archivault sculpture.

His detailed carving is as carefully done as it was last time he was here. His decoration is invariably crisp and geometric, though in the lintels he more or less followed the patterns Bronze had started.

Red continued this work, for now that the
irksome restrictions imposed by the delays in
the Job doorway had been removed, work
could advance quite rapidly. The state of the
work in the N.w doorway is hard to draw at
this scale and from this angle, but it was not
much more secure than it had ever been. The
XV:14,15 six courses laid in the NW stair had brought
the terminal wall up to the level of the arcade
capital from which the arch could be set up
which would finally secure the last bay of the
triforium.

The encasing of the N.e temporary roof was
XV:9,10,12,17 completed by Cobalt, and he designed a
number of windows in the north. The king’s
recesses over the north porch were completed,
XVI:38 and quite a bit of sculpture. The flanking
buttresses were not taken any higher at this
stage, and would not be until 1218, by which
time all the porch vaults, the flanking
sculpture, the vaults and their carved
archivaults, and the roofs over them would all
be finished.

XV:24 In continuing this work Red laid the barrel
vaults in the spaces between the doorways, the
XVI:29,38 last of the bands of leaves over the western
lintels, and he started the vaulting over the
N.w porch.


ROSE U
1214

XVIII:53 His major decision was to locate the height of
G:XVIII-E the vault springing, using a pentagonal
geometry. Though other masters adapted to it,
most of them completely ignored these caps in
working out later geometries - it was too
strange for them. I think it was placed lower
G:XVIII-E,F than Scarlet would have wanted, perhaps
lower than Bronze's or Ruby's either.

XIII:1 His corbels finish the passages over both the
XVIII:29 triforium and clerestory walkways. He laid the
XIII:44 cornice over that on the WS.I buttress only.

In the clerestory wall see how, as in the arcade capitals, the central piers were more advanced than either of the larger piers at the ends, for their caps were not to be installed until the next campaign.

In the western wall between the towers he may
XIX:33 have carved the leaves over Cobalt's projecting
figures, and some of the wall over that. In the
lower three or four courses there are
irregularities where the wall meets the curve of
the rose, suggesting that these stones may have
been trimmed in place to suit the large
diameter of Scarlet's window. Rose's vaults in
G:XIX-C the crossing suggest that he would have placed
the other vaults lower than Scarlet intended.

Inside, against the towers, he began the recesses for the false clerestory that, with its twin lancets and circular roses, were to be painted in imitation of stained glass. Did he really feel that the towers should not have been there, or was he of the school that wished to open the western clerestory windows directly into the towers, as would be done in the transepts. The Romanesque towers had not been designed for this purpose. The past 50 years had changed much.

Rose laid the last sections of the west transept
XVIII:10,21,23 passage cornices, with the corbels over the
XII:32 triforium passage under them, and the nearby
triforium roof. In NW.I he laid the plinth and
the rest of this wall to his corbels, but did
XVIII:23 nothing to the SW.I pier. The reasons for this
will become clearer later.

These mouldings are identical to the cornices
XII:32 and corbels he laid in the straight sections of
XVIII:7 the choir. In the choir he located the height of
the upper string course, with a section like that
XVIII:10,12 in the nave, but placed slightly lower to suit a
different geometry. This included finishing off
the triforium passage in the apse, and all the
cross walls. This was made easier for him as he
did not attempt to fill in the space between the
II:26 stepped coursing of the cross walls and the
XVIII:30 underside of the roofs, as had been done in the
nave.

The ends of the triforium walls overlooking
the delayed north end were heavily encased
II:12 within timber scaffolding to secure it and to
XV:19,20 prevent movement. The many putlock holes in
these bays show how much was involved.
Though it must have impeded the builders
access to these areas, it secured these
unrestrained walls against high winds and
accidents.

XII:42 Over the perimeter buttresses of the sanctuary
XVIII:6,16,30,76 he laid more cornices, and as in the nave laid
XIII:1,12,18,44 them above his corbels which capped the
XVIII:18 walkway passges. One of them has a 'tumour'.
At the same time he seems to have carved a
XIII:43,44 number of additional cornices which were not
used until later, often being recut. They may
have been intended for the clerestory, but were
not laid, and were recut by Scarlet to suit his
window scheme.

It is interesting to see that the sanctuary buttresses were then at the same height as those in the nave, though the nearby clerestory wall is eight courses lower.

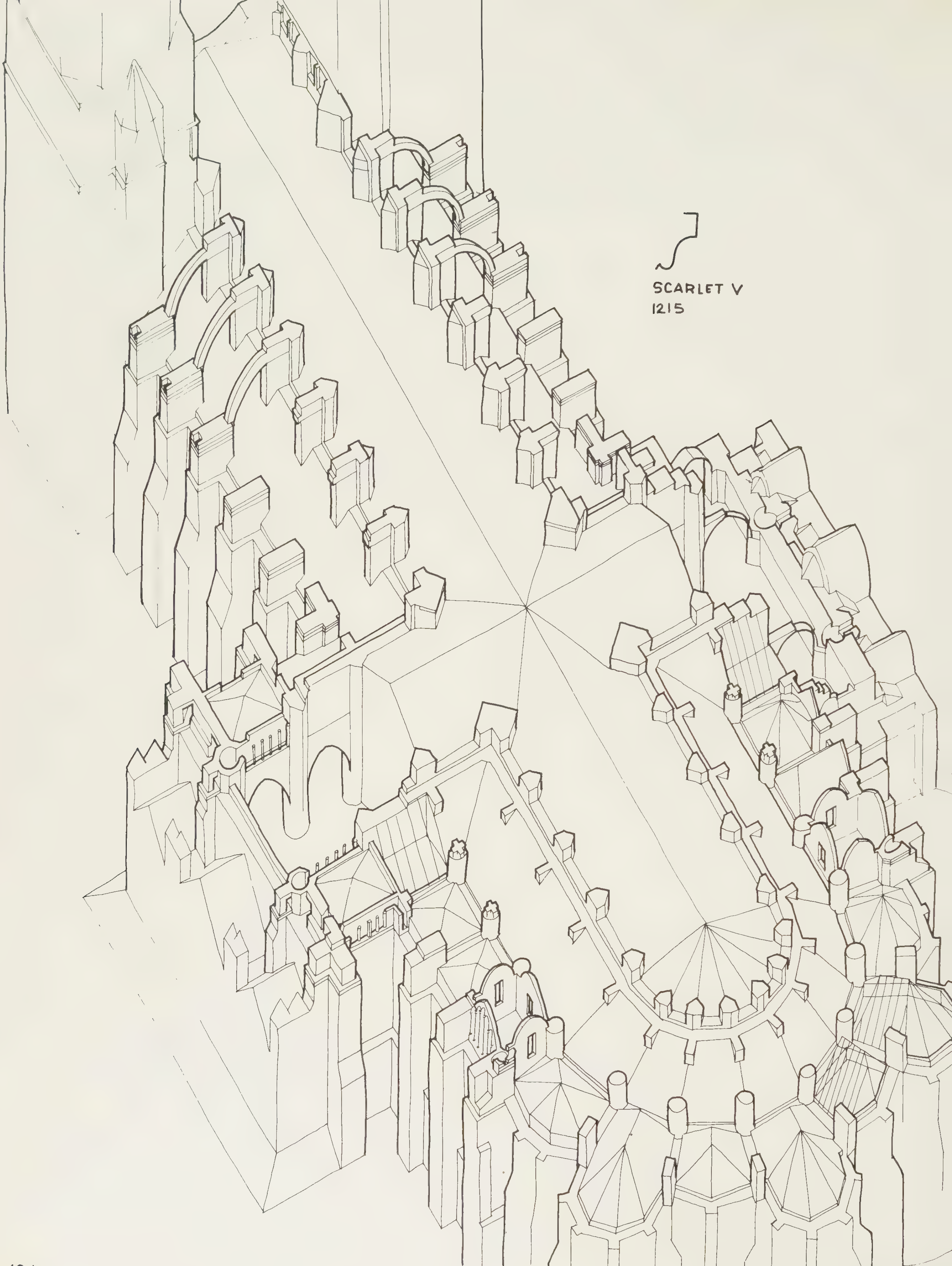
He laid one course only in the corners of the
XIII:1,7,17,18 passage round the SE room, but this did little
more than tidy up the walls around the site
XIII:17/f offices. But it included the decision to omit the
XIII:1,3,22,34 curious projection on the east side of ES.I.
XIII:24,58 Except for one corbel and the north jamb of
XIII:12 the SW-W window and some rib supports, no
work was done to the SW room. I presume
that this room may have been roofed at this
stage.

XII:32 Inside he carved six triforium arcade columns,
ready to be stood up and arched over in the
XIII:56 next campaign. Also the last of the arcade
plinths in the SE corner and most of the
columns in this bay.

XII:38 He probably carved the crockets over the
southern santuary roofs, thus finishing them.
XII:35 He began the north sanctuary roofs with their
XII:38 overlapping slabs, and the delicately carved
screen walls with their steep gables in front of
EN.II and III rooms. He did no more than two
courses of the roof over E.I chapel and around
the apse he may have begun the wooden roofs
with the steep pitches, like those he used in the
north sanctuary.

He left the top of the apsidal tower rooms
walls as Red had finished them, and just
XIII:37,43 brought up the buttresses on the external
corners up to one common level. He may have
XIII:36 set down the column bases to the delicate
XII:42 screens in front of the apsidal towers. He too is
concentrating most of his energies on the
clerestory wall, and this pattern will be
continued for the next dozen years until the
vaults are completed. This is why for every one
course laid around the perimeter three will be
laid inside, producing the endless changes
found in the former, but at the same time
providing all the clues needed to unravel the
history of the latter.

XVI:38 Rose completed all three north porch vaults,
XV:24 raised the walling, filled over the lintels and
prepared for the roof and gutters. This formed
the solid base on which the stability of the
pitched roofs would depend, and like the zone
of the aisle vaults, had to be strongly
constructed.


SCARLET V
1215

SCARLET-V 1215

XVIII:53 He carved the remaining capitals for the nave
springing, with the imposts over them, from
XVIII:49,76 the crossing to the western wall. Over this were
G:XVIII-E placed the projecting seatings for the flyers,
XVIII:47 the first bases for the spokes and all of the *tas
de charge* on ten of the sixteen piers. The three
XVIII:43,68,77 western flyer arches on each side, being the
ones furthest from the cranes, were laid up,
XIII:44-45 and at the buttress he laid nearly all the
cornices and moulds that support them, and
began to encase their outer ends in walling.
With this he designed the ostiums that recess
XVIII:49 into and lighten the outer faces of the
buttresses.

XIX:33 Scarlet also began the lower part of the frame
around the western rose, and presumably
began cutting the stones for its plate tracery.
XIX:30,31 Most of the capitals in the rose are his, but a
XX:20-24 few are recognisably Ruby and Bronze, and so
I would presume he began the stones in this
XVIII:75 campaign, that the other masters continued it
G:XVIII-E in ensuring campaigns, and that he finished it
when it was installed in 1218. The diameter of
the rose implied a vault height of over 35
meters, some 1½ meters more than was built,
and I would therefore presume that though
Scarlet seems to have adapted part of his
geometry to suit Rose's imposts, he would
have preferred a higher springing point.

On the western side of the crossing he
XVIII:53/b continued the central shaft on the diagonal
face of each pier through the capital, as if
intending to build a lantern over the crossing
as at Laon.

XVIII:15,16,21,25 He completed the cornices in the choir, laid all
the sills with his projecting internal roll-
G:XVIII-D mould, and designed the piers to a lighter
format than those in the nave. I have drawn
XVIII:30,76 the temporary roof over the whole choir,
though it may have taken a little longer to
build.

So now in 1215, some 20 years after the fire,
the cathedral was for the first time opened for
its full length under a lofty roof, giving a
dramatic and inspiring foretaste of things to
come. It is noteworthy that the funds spent on
the fabric seem to have risen significantly
VI:45 from this time on to the completion of the
main vaults.

Scarlet began the sloping copings over the
XIII:43 octagonal piers under the flyers that
transformed them into a cross. The width of
each arm matched the width of the flyers he
was then constructing in the nave, at one tenth
of the bay.

He continued to lay cornices over the
XIII:44 sanctuary buttresses, adapting a number of
Rose's to suit his needs. He seems to have
completed the screens in front of the apisdal
XIII:36/h tower rooms, with their delicate arches,
though the diagonally placed bases may have
been Rose.

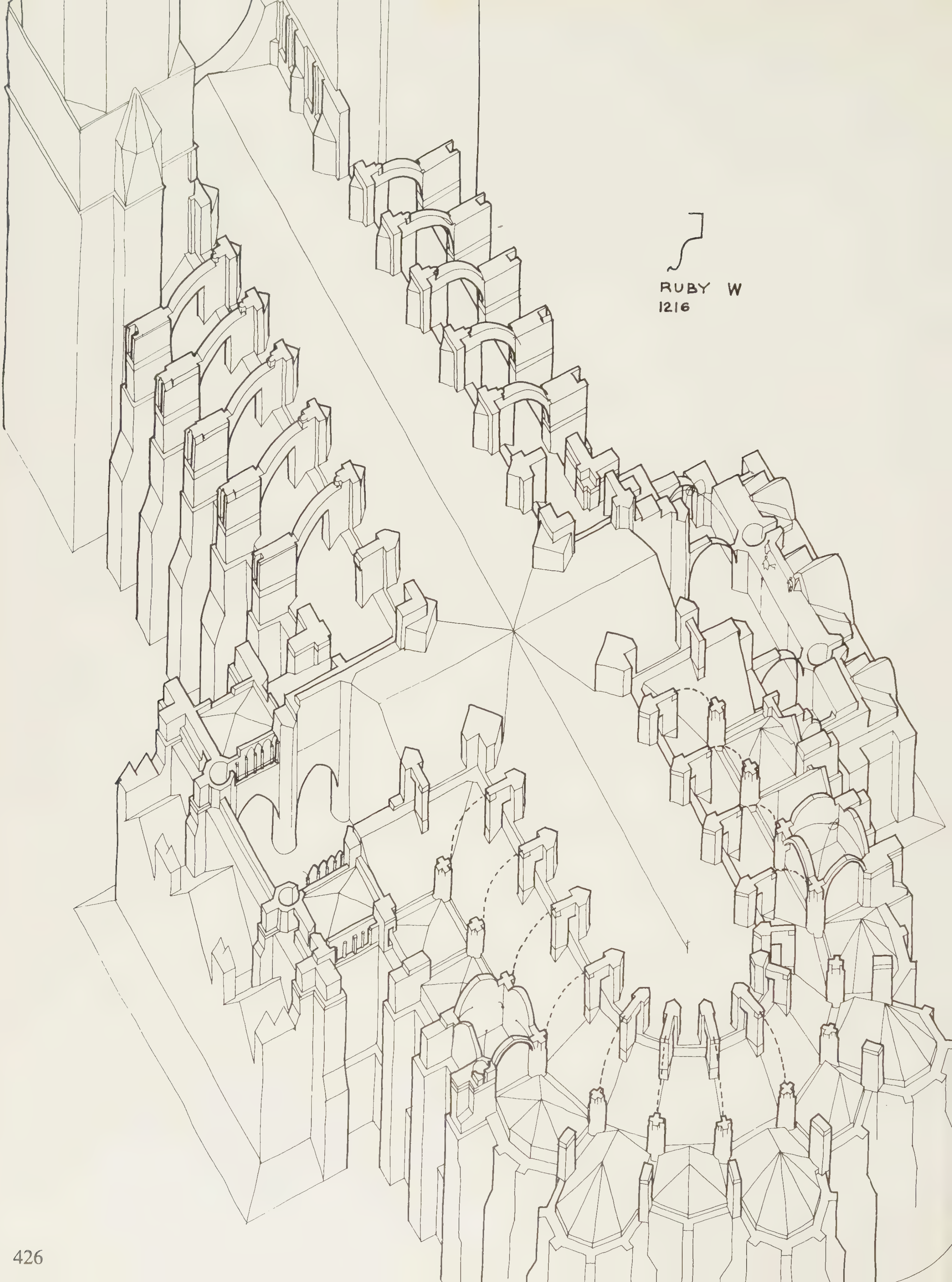
He designed the large windows out of the
eastern face of these stairs, and the inclined
XIII:46 sides to the buttresses that transform the
irregular shape at triforium level to the square
at the clerestory. At the other corners of the
apsidal rooms he brought them all up to the
springing of the large arches encasing the
XIII:43 tower. The walls were brought up to the
underside of the arch so its voussoires could be
placed directly onto them, thus eliminating
formwork. To maintain a uniform height all
round the side arches were to be pointed, and
the inside arch round. In the next campaign all
three in both towers would be erected, and
with them the interior ribs of the room vaults.
This vault would then be completed in the
campaign following, along with the exterior
arches over the screens. As in the earlier crypt
vaults there was an orderly progression of
work in which the inner parts furthest away
from the source of supplies was always
somewhat higher than the outer parts.
Materials never had to be lifted higher than
necessary.

XIII:3,18 Virtually no work was done around the SE
room, but he brought up the SW level with the
former, with his corbels over all the doors and
XIII:1 passages, including pulling one of Rose's
XIII:22 corbels outwards so it would appear to match
his own. With the corbels he built the south
XIII:24,58 jamb of the SW-W window. Inside he laid the
XII:32 last of the arcade plinths, the rest of the
XIII:56 columns for the southern-most bay, and stood
them up, and began the arches over some of
them.

The NW.I pier over the clerestory may have
risen by one course, but was waiting on its
opposite on the east to catch up. He did almost
nothing for the SW.I pier, though the SE pier
opposite was now some two courses higher. He
XVIII:23 may have cut one block of stone for it, but it
was not installed. In contrast Rose had in the
previous campaign raised the nearby perimeter
buttress higher than all the others. The
explanation for both of these imballances
would seem to be in the hoisting. One of the
gangways for materials may have passed over
XIII:32 these two piers. But to supply what?
Something to the inside of the building, and
this would, I think, have been the temporary
roof, with its mass of timbers, and whatever
covering they used, be it straw, shingles or
lead.

In spite of the apparently increasing gap
between the transepts and the central vessels,
Scarlet continued to concentrate on the latter.
He did not see any insuperable difficulties in
this arrangement.

In the north he continued laying up the roofs
XV:40 over the porches, reaching the level where he
G:XV-A could lay out the buttresses and the walls
XV:36 between with their projecting prows. This
included the doors from the north stairs onto
the roof. He possibly carved the Creation
XVI:38 Cycle around the outer arch of the N.c porch.
By this time the last two aisle windows
adjacent to the porch had been completed,
XVII:27 thus tying the terminal wall into the rest of the
building.


RUBY W
1216

RUBY-W 1216

XIII:24 He cut and placed up to six courses around the
XVIII:49 perimeter buttresses of the nave to stabilise the
flyer arches, and installed another two arches,
though to a different arc and geometry to
Scarlet's. He did little to the clerestory walls.
XVIII:76 There is an alternation, an ebb and flow of
work here between the wall and the buttresses.
In the last campaign most of Scarlet's efforts
went into the wall, and this time most of
XIX:33 Ruby's went into the buttresses. It makes good
constructional sense when you think of it, for
the steeply sloping lower part of the flyer arch
needed stabilising, while the upper part was
securely anchored by the weight of the *tas de
charge*.

Ruby finished the ostiums in the west up to
XVIII:49 the edge of their gabled roofs with 3-foil round
arches - a common Ruby detail. Nevertheless
the uppermost course from this campaign was
still some 2 meters below the springing of the
clerestory.

XVIII:64,76 Nothing was done to the SW.I pier or
XVIII:23,24,53 buttress. The recess for the flyer arch left in
the buttress is illustrated on the NW side. He
carved the capital for the NW.I pier.

Just as Scarlet had earlier concentrated on the
nave wall and done less to the buttresses, so
XVIII:30 Ruby in this campaign did a lot more work to
XIV:15 the choir wall than to the perimeter. He laid
XVIII:21 the plinths to the outer leg of the piers, with
XVIII:27-29 the shaft bases, and the whole height of the
G:XVIII-B,F pier to his corbels and the springing caps. He
XVIII:53,76 carved all the capitals to the choir, including
the bec caps to the apse, and to the adjoining
XI:49 transept bays. The crossing was, of course
slower, and its caps were not laid until the next
year.

XVIII:30,58 The formwork for most of the flyer arches,
and their voussoires were reduced in width
from those in the nave to 2^{EF}. Those in
XIII:43/aa the apse may have been erected a little later,
XIV:8 while those to the eastern side of the transepts
had to wait some years. However from the
central pier E.II he began the outer arch that
was to support the thrusts from the transept
flyer.

Round the perimeter he built the large arches
XIII:43 which encase and form the final bulk of the
apsidal towers, the ribs for their vaults, and in
XIII:36 the north the large central boss. He also
XIII:44,46,47 designed and began the recesses for the
aedicules, certainly in the bases laid to EN.IV,
and posibly elsewhere. This reintroduced the
colonnetted scheme - if in a different guise. It
lightened the mass of the buttresses, terminating
them in little houses in the sky. Though
he may not have intended to cap them with the
pointed roofs we find today, the intention was
to hide the bulk of the structure behind a sheaf
of verticals.

XIII:1,3 Around the southern tower rooms he may
have laid one course, with one pair of corbels
over the SE-S lobby, and another over the
eastern external passage. These rooms were
probably still being used as site shops. Notice
how often doors and passages are taken to the
top of the corbel, and then work stops at this
level. It is high enough to permit men to move
through these openings, while the upper
surface is above head height and so can
support another level of scaffolding. Further,
to lay the next course of lintels would have
required another staging for the workers to
stand on. For all these practical reasons the
top of the corbel was a favourite place for
joints between campaigns.

XIII:17/h With the cornice over the corner pier of the SE
room he began an inclined flashing stone for
covering the adjoining triforium roof. It was
not continued, but is one of the details that
IX:33 links him with Rose, who built the flashings
XVII:14 in the north.

XIII:56 He also laid up the arches over the west side of
the triforium arcade, and maybe some on the
east.

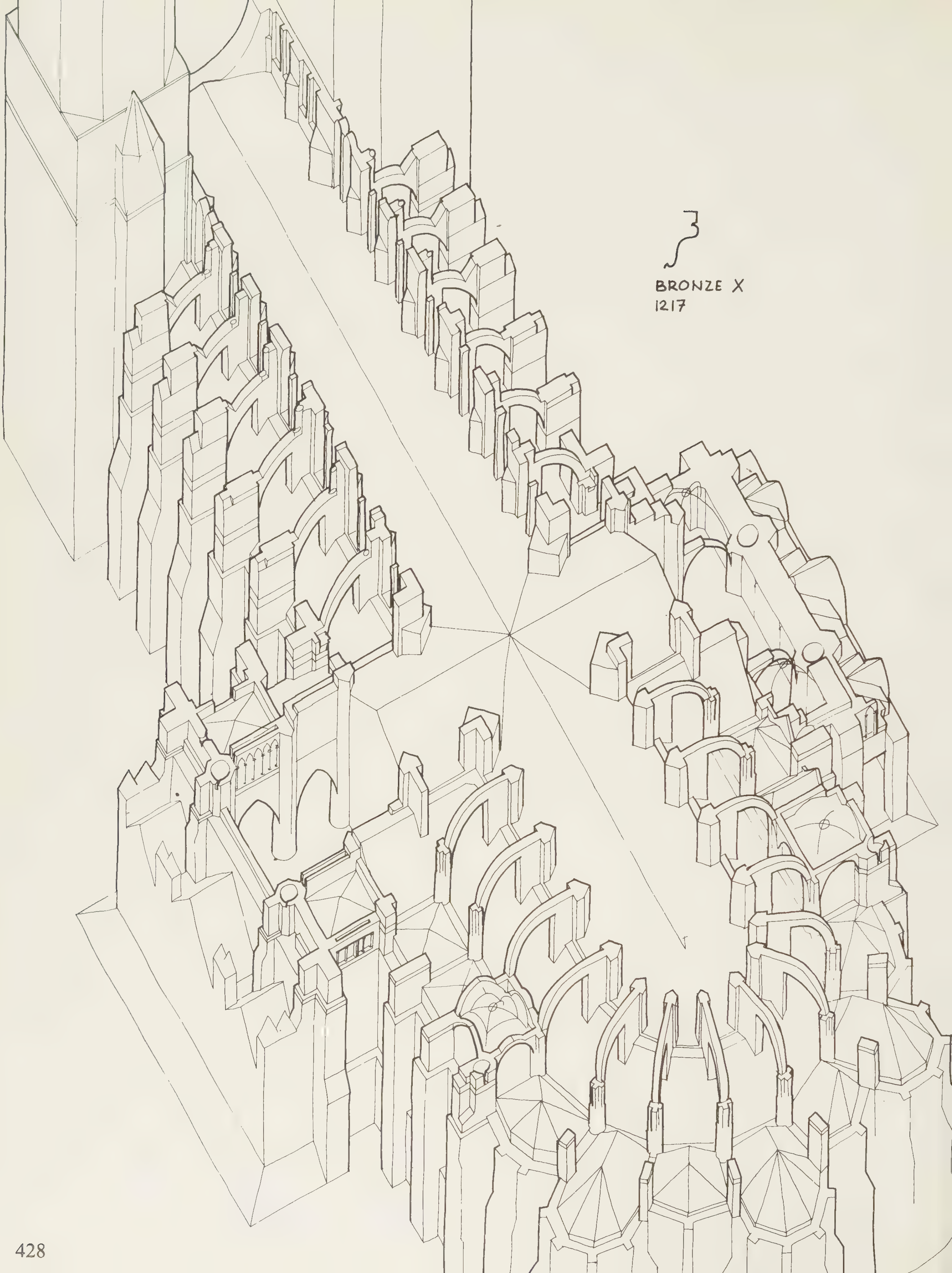
See how far above the southern rooms the
eastern ones now are. Where the south is no
higher than the doors, the east is within one
course of the clerestory. They had to be
XVIII:30 pushed ahead to support the flyers to the
choir, while the south were too far away to
help stabilise the crossing.

Over the north porch he continued to
XV:15 construct the roof, and a couple of courses of
walling just following Scarlets arrangements.
XII:6 In the western aisle his cornice shows that his
walling must have come up far enough to
XI:34 allow him to build the ribs and the boss. It was
an important moment, for the vault was
essential to lock the end bay into the terminal
wall so that the triforium and clerestory
thrusts could be held. I imagine there would
have been a lot of strutting and other
timberwork around here securing the higher
levels, and the masters would have looked
forward to the day when they could be
removed .

On the inside he capped over the four thin
XV:40,42 shafts which decorate the terminal wall, and
began the arches to support the gallery
ballustrade. This was quite different to the
arrangement in the south.

XVI:38 Virtually nothing could be done to the porches
until the roofs over them were more advanced.

XIX:33 In the west he carved a few recognisable
elements in the rose, which shows that here,
XX and probably unlike the transept roses of the
next decade in which Ruby had a part to play,
the rose was not entirely premade by Scarlet's
men, but was produced piecemeal over many
campaigns.


BRONZE X
1217

BRONZE-X 1217

Bronze completed the last of the nave flyer
XVIII:49 arches, to a third radius, though not the
G:XIX-B adjoining ones to the transepts. There he only
XVIII:50 installed the lowest voussoires over which later
masters built an arch of a different curvature.
Over the buttresses he completed the three
western gables over the ostiums, with the small
XIII:62 4-foils carved into them. The uppermost stone
XII:38/V with the ridge and crocket were not placed
until 1219.

The buttresses were now high enough to encase
XVIII:49 the gussets, at least in the west. The heaviness
of these flyers were reinforced by this element.
They are solid, without the openings through
them that Cobalt introduced into the choir,
and the same thickness as the arch. This gives
the impression that the upper and lower arches
of the flyer form one wall, through which
there is an opening decorated with spokes.
Whoever invented these gussets, and I think it
may have been Bronze, ensured that the
spokes would be set radially. Chartres is the
only remaining medieval building with the
spokes set this way. All the others are vertical.

Against the clerestory wall he carved a few of
XVIII:57,76 the caps over the flyer spokes, setting their
height, and thus the squat form of these
columns. The underside of the capital is
usually level with the springing of the arches
XVIII:6 over the lancets, and he began some of them.
XVIII:61 This meant that some courses of the mullions
would have been in place earlier than this.

The height of the high vaults was located from
the top of the rose, and the rose sat over the
XVIII:75,76 lancets. Thus by positioning the lancets he
limited the possibilities for the vaults. From
G:XVIII-E here on it would be inevitable that the vaults
XIX:33 would be lower than Scarlet had intended, and
the spokes a lot squatter.

The lancets are not all the same height, for
XVIII:6 where the bay is narrow the rose would be
smaller, and so he raised the lancets to keep
the tops of all the roses in line.

The first bay by the crossing was delayed by
the slower pace of the crossing pier, and the
crane-induced delays in the corner buttress.
XVIII:23,49,76 Work on the temporary roof must have been
finished, for three courses were laid over the
SW.I pier, and this could only have been done
XVIII:64 once the access gangways had been removed.
The tilt across the nave had been eliminated
during the pause while Olive-Q waited for the
results of the competition, and so the two sides
of the nave, and their adjacent transept bays
were virtually at the same height.

Bronze laid the last caps around the crossing,
including over the central shafts, showing that
he wished to place a vault over the crossing
rather than continue the interior space into a
lantern. He laid another cap in the apse and
XVIII:53 one over the NE.I pier. Around the choir he
completed all the flyer arches, and began the
XVIII:30,47,76 *tas de charge*. Much care had to be taken in
erecting the central flyer piers as they were
excessively thin. Each course had to be
carefully and accurately laid, and to make
matters worse each pier had to be enshrouded
in its own scaffolding.

XIII:43 Around the apsidal towers he laid the outer
row of voussoires over all the inner walls, and
on the outside both rows of arches cut from a
templet identical to his corbel, and to the arch
over the upper choir flyer spokes that he would
carve a few years later. He laid the boss to the
XIII:36 ES tower room, and probably completed the
cells in the EN, this room being one course
higher than the south. Bronze also finished the
XIII:44 last of the buttress cornices, and altered
XIII:46,47 Ruby's scheme for the aedicules in the ES.IV
with engaged corner columns encased within
G:III-E his corbel moulding, as in the north porch
piers.

He probably began the central columns in the
XIII:47 other aedicules, with alternating circular and
octagonal shapes, set on diagonally placed
bases.

Notice that both E.III buttresses were less advanced than the others, for the men seem to have brought vaulting materials and filling through this corner.

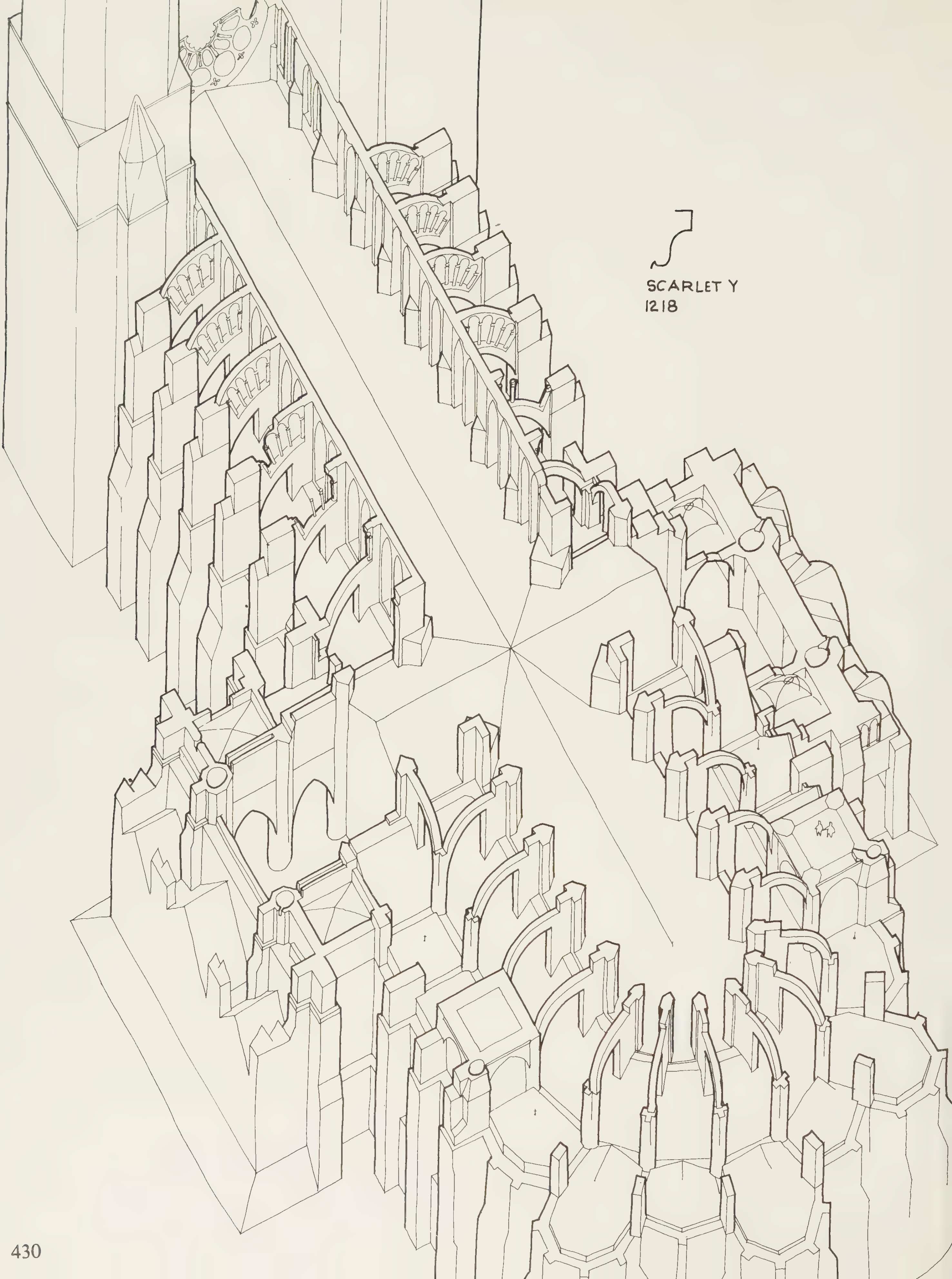
He laid some three courses around the SE
XIII:1,3,17 rooms, to the top of the eastern passage,
including some corbels. He continued with the
XIII:56 arches over the interior triforium arcade, and
XIII:18 outside on the east he laid the flat lintels over
the screen, to the splayed corbels at the top of
the passage. The columns to the screen must
have already been in place, set up with
irregularly spacing, to justify the flat lintel.

Similarly in the SW he laid three courses,
XIII:50 began the SW-S window, and the corbels over
XIII:1,56 the doors from the stairs into the triforium.
XIII:57,59 Outside the west wall he erected the screen,
and began to lay the voussoires of the big arch
over it as they could be supported on the
screen.

The roofs over the site offices did not have to be removed just yet, though the need to build the vaults over them would force them to do so soon.

Within the southern stairs he designed the
XIII:1,50 SW.93 window and half of SE.104, with a pair
of corbels over the lobby of the southern door
into the SW room.

He carved the last few archivault figures for
XVI:38 the outside of the north porch, some of which
were by the Modeste gang. Did a lot more of
XV:15,36 the roof, but not all. Most of the work done in
the north was bulk walling, with both the
inside and outside skins and some two meters


SCARLET Y
1218

XV:36,40 of filling in between, as his corbels out of the
N(p) doors show.

He carved the boss with the Blessing Christ
XI:34 over the last eastern aisle, being now twelve
years after his first in the nave. No doubt he
was finishing over Ruby's cells in the west.

The arches over the 'arcade' on the eastern
XVII:1-7,27 side of the porch were begun here, suggesting
that the setback for it and the columns had
been started earlier. In the south Bronze had
deepened the recesses to make more room for
III:18 statues, but it was too late to do so here.
Possibly begun by Scarlet a few years earlier.

XVI:40 The *jubé* to the west of the choir stalls may
have been begun in this campaign, with the
depressed griffes in the columns typical of
Bronze, and some of the carved panels like the
Adoration and the Walking Magi.

SCARLET-Y 1218

The wall around the western rose would now
XIX:33 have reached the midpoint, and it was almost
XX:20-24 time to turn the arch over it. The stones of the
rose would have had to be installed by now, all
84 of them, with an immense amount of
scaffolding soaring above the encasing walling
to hold it in place. I imagine that all its stones
would have been carved in the previous three
campaigns, and that erection began in the last.

Scarlet seems to have concentrated on the
XVIII:49,57,76 nave, carving many of the spokes and the
arches over them. More for convenience than
anything else I have shown him setting up all
these arches, though the erection of these
G:XIX-B inclined spokes would not have been easy, and
may well have extended into the next
campaign.

Along the wall he completed all the arches over
XVIII:6 the lancets, the underside of their frames for
XVIII:76 the roses, including the elliptical one in bay I.
Around the perimeter he extended the
XVIII:49 buttresses up to the start of the drip, above
which it is set back. Thus he is probably
responsible for placing the buttress pinnacle
over the inner part of the buttress, rather than
the outer, where it would function properly.

The corner buttress was still held back, though
the wall itself with the rose was almost at the
XVIII:6,76 same height as the rest of the nave walls. He
also did the lancets in the first transept bays,
XVIII:23,29 the corbels over the SW.I pier, but not the
XVIII:53 vault cap which, with the flyer arch, was not to
be laid until the next year. However, on the
north side the complexity of the joints are not
as chaotic as in the south. The spring cap had
been laid two years before, and so I presume
that the lower flyer arch was laid in this
campaign with the two on the eastern side.
Even here on the choir side the lancets show
that the south was a little slower than the
north, presumably because of the delays in the
SW.I pier. The temporary roof and the
necessary access way for materials had left its
mark.

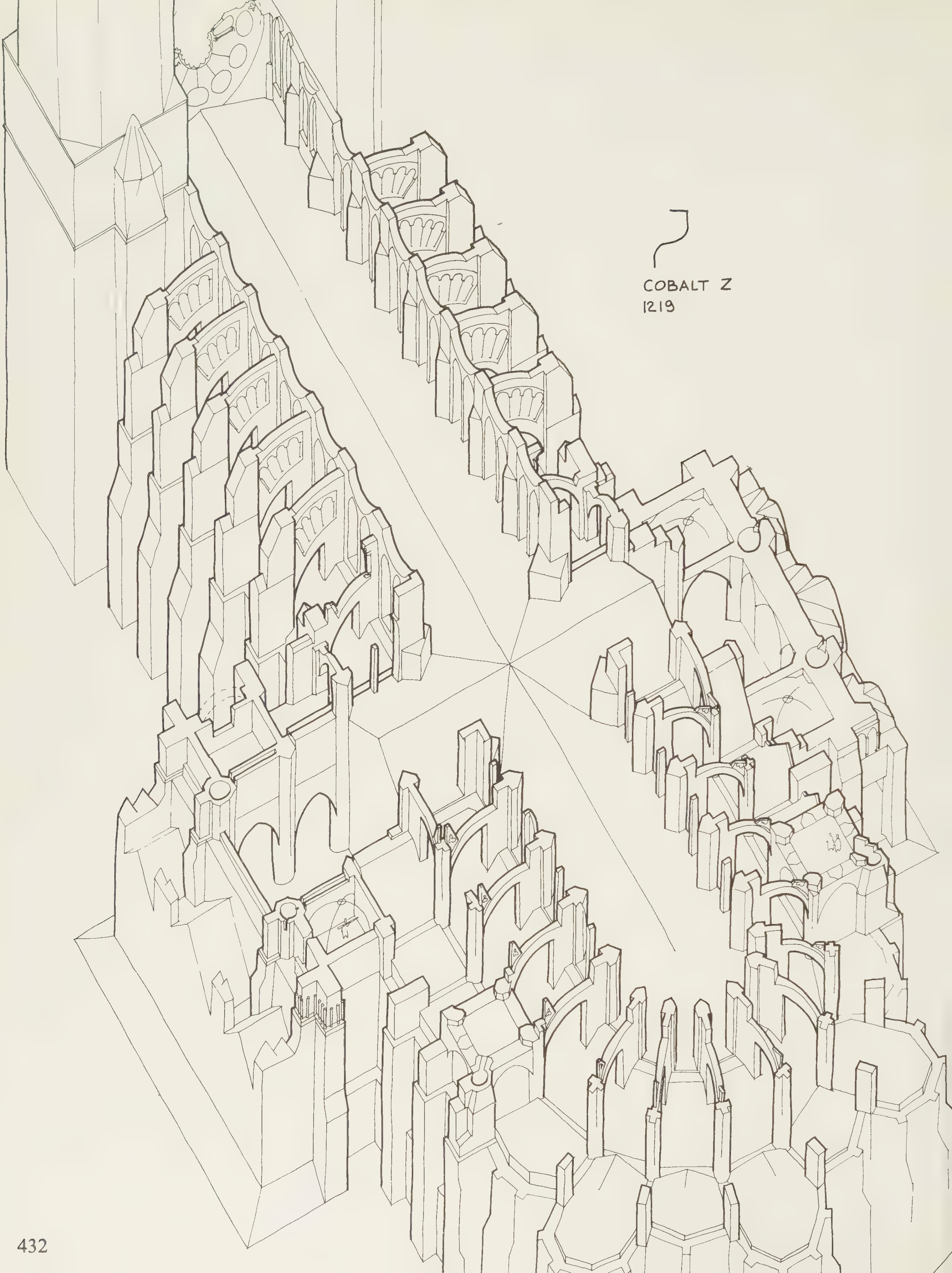
XVIII:30,47,76 In the choir Scarlet built to the top of the *tas
de charge,* with the projecting pilaster over the
flyer arch. There are no bases for the spokes as
in the west. I have presumed that these western
bases were Bronze's decision, while the lack of
them was Scarlet's, though he may have
intended to carve the bases with the spokes.

XIV:2,6,14 Nearby Scarlet set out the platforms for both
apsidal towers, but only in the north did he
XIV:4,5,8 design the lowest courses of the piers and the
G:XIV-A doorway. Its very 'Gothic' arrangement, with
piers encased in dense clusters of shafts, and
with the geometry dependent on the rib shafts
rather than on the walls, seems to be a more
advanced design than any of the other and
later towers.

XIII:43 Meantime he was completing the lower flyer
XVIII:30 arches, and raising their supporting piers
around the springing - a slow job involving a
great deal of scaffolding.

XIII:3,17,18,56 Little was built around the southern rooms,
just one course or so, but quite a bit in the
XVI:38 north. He carved the last of the outer porch
archivault statues and finished the band of
XVIII:1-7,27 leaves around them. He began the uppermost
course over the lintels, and the rest of the
arches over the lower side 'arcades'. He
XV:36 continued with the roofs over the porches, and
as these interlocking stones rose he built the
wall over it, and the prows with them. This
XV:38,39 included the two large windows out of the
G:XV-B stairs. Inside the wall was now high enough to
enable him to lay up the cell over the last aisle
vault, and the filling. Began the NW-S door
XII:10 from the as yet unformed NW room, while
XII:6 completing a cornice nearby.

The stage was now set for the triforium level in
the north to be set out.


COBALT Z
1219

COBALT-Z 1219

XVIII:5,6,76 XVIII:63 Continued the surrounds for the nave roses up to and including the capitals and corbels supporting the arches over them. The elliptical form in the first bay was changed into a circle XVIII:5 by inserting a tapering arc of voussoires. Cobalt may have begun to carve the roses themselves, and began setting them up. Once in position no further formwork would be required for the arches and other stonework over them.

XVIII:76 The crossing piers were raised to the same height as the rest of the nave, as Cobalt's capitals show. The coursing indicates the vertical joint abuts the first transept lancet arches. The size of this pier would have helped to stabilise the end of the clerestory wall while waiting for the flyer in the first bay to be completed.

XVIII:49 He finished the round arches over the spokes, and most of the second flyer arch over that. It just rested on the spokes, again without the need for centering.

XVIII:64 The spokes in the first flyer remained unfinished, save for the gusset. It was being held back by delays in the corner buttress which was to support it, which was in its turn being delayed by the first piers of the nave. We could again look to access for materials as the reason, and the possibility that there may have been a crane on the inside of the building by the first western pier of the transept.

XII:38/V The many crockets on the nave buttresses may largely be the work of Cobalt. This shows that both rows, over the ostiums and over the gables, may have been put in together, presumably as the last work while the encasing scaffolding was being pulled down.

XVIII:23,47,53,57 The SW.I springing cap was put up in this campaign, with the lower flyer arch. Work could then be pushed on quickly in the corner buttress.

It would have been quite clear at this time to anyone working there that the character of the nave flyers was massive and archaic in its detailing, with squat spokes and round arches between them. When Cobalt arrived the only difference between the nave and the choir was that the cross-section of the lower flyer arch XIV:8 was a little smaller. But the gusset could have been as thick as the arch, and the spokes could have been articulated similarly to the nave's.

Cobalt changed all this. He made the gusset XVIII:30,45 into a thin plate, and pierced it with a trefoil XVIII:58,76 opening. He then carved the spokes as squares, set them pointwise, and omitted the bases and caps. These two decisions, plus of course his successor's (or his) to use the pointed archs over them, did more to alter the appearance of the east than anything else. For the design of the cathedral, it was a very important campaign.

XVIII:49 G:XVIII-E Cobalt finished the *tas de charge,* began most of the lancet arches, more or less following the heights found in the nave, and presumably succumbing to the client's instructions to XVIII:6,58 follow the general *pavee* in the west. However, unlike Bronze, he maintained an even height to his lancets, no matter what the width of the bay, so that the tops of the roses could not be in line. The lancet springing shows that at this stage the NE.I wall was still ahead of the XVIII:50 south, though the flyers were not. However this side of the transept kept up with the choir because the masters had little choice, as the flyer arches and the gussets to them had to be built into the pier at the same time as those in the first bays of the choir. In one sense this begs the question, for in the nave they resolved this by delaying the flyers in the nave, rather than pushing on with the transept. It would seem that it was important to get these arches up if possible, and so I presume only other factors would have prevented them doing so on the western side of the transepts.

In the second pier the lowest voussoires of the outer support arch to the transept flyer was carried up as high as possible without formwork. Until the stonework in the first pier rose high enough to take the upper end of the arch this is all they could do.

XIV:4,5,8 G:XIV-B XIV:14 Cobalt laid the remaining pier plinths in the EN tower but was able in the ES to set it out to his own plan, being more mass and wall-conscious than Scarlet's. He raised the jambs on the west of the EN stair door to the XIV:5 corbel, and the ES to the tori. We have seen XIII:46 this manouevre before, for it allowed free access out of the stairs while providing support for work above that. As the site workshop may have been moved into the rooms under these towers I can understand the masters wanting easy access to the clerestory level.

XIV:14 XIII:46 He tidied up the top of the wall around the stairs, but only on the west side of the EN stair did he lay any part of the cornice for the octagon that was to encase the stairs a little higher up.

The perimeter buttresses had been built to the cornices some campaigns earlier, but no more work was being done to them over these campaigns as they provided a splendid platform on which gangways could be built for the delivery of materials. There was no point in continuing them until the upper flyer arch was reached.

XVIII:30,49,76 Notice that the walls of the nave have been rising consistently faster than those of the choir for some years. It reflects the difficulties of scaffolding in the east where the arches, piers and spokes all needed careful support. By comparison, in the west one course could just be set upon another, and even though arches were involved, the only staging required was support for the workmen. The difference is in the order of 6 meters, as opposed to 4½.

XIII:3,18 He laid a couple of courses around the SE
room. The other room was still a little lower,
its ribs and bosses being one campaign later
than the east. Cobalt probably began fixing
the colonnettes on the east to their bases,
XIII:17 attaching them with iron cramps into the joints
of the buttresses. The north walls to the rooms
would now have been almost level with the
underside of the clerestory cornice. This would
have been the time to remove the roofs over
the southern rooms, and to begin the ribs, at
XIII:3 least in the east. I presume that the site shop
was removed to another elevated position,
preferably on the sunny side, and possibly
under the ES tower now vaulted, roofed and
XIII:43 well lit.

XIII:51 Within the southern stairs Cobalt's treads are
generally doubled, two treads being cut from
the one stone. As those of his successor Ruby
XV:40 are always singles the joint between these two
campaigns, in the north as well as here, is
fairly clearly marked.

XV:39 On the north side he altered the shape of
Scarlet's windows, and raised the height of the
XV:36 terminal wall to within a course or two of the
gallery floor, probably completing the arches
on the internal face. He eliminated the 'prows'
over the roofs of the side porches, and formed
XVII:3-7,27 the set-backs in the buttresses at each end for
the second row of 'arcades'. Over the porch
XVI:38 gables he carved the upstands for the bases of
XVII:2,3 the arcade, showing his interest in continuing
this screen across the front of the transept. On
XII:10 the east side of the NE room he began the
XVII:10,27 external arcade that screens the walkway
matching that on the south, with his typical
plinths with unequal splays.

Now, after 26 building campaigns, the cathedral appears close to completion, with more than three quarters of the work built. Yet there will be another thirty or so programs to the top of the gables. Even after the last stones of the nave and choir vaults were to be finished, the same number of masters will still be needed to complete the transepts as had earlier raised the whole of the cathedral. The enthusiasm in the last years of the works, and the funds required to pay for them, were indeed diminishing.

EIGHTEEN

The clerestory

In my thought I mould the invisible space with geometrically defined shapes in combinations, and when I have established the void I want, I freeze the situation in my mind. Because I have moulded space with geometrically defined shapes, the whole enclosure of the void is fully defined and the surface of the enclosure is divisable into a number of similar elements - and, when their relationship has been clarified, they can be assembled like a big jig-saw puzzle in space.

Jorn Utzon

There is an intrepid splendour about the medieval mind. Their vital feeling for materials is nowhere more clearly expressed than in the elegant flyers of the choir which delicately withstand both wind and gravity. From the ground they are far away and hard to define: but up among them you are exhilarated by their enormous audacity. The stone denies its nature, it is so slender. Set against the massive towers and the thick walls these tenuous arches appear too etherial to have stood these last seven and a half centuries. Only occasionally repatched and remortared, most of the stonework is now as it was when Saint Louis first saw it.

Chartres is a place of extremes, for there is no other Gothic building with flyers as slender as those round the choir, nor as massive as those in the nave. The great contrast between them has animated most of the arguments on the building's history. But a close analysis of the flyers, together with all the other information the building has to offer, yields an extraordinary saga: the enormous members in the nave with their plain thick arches and massive arcading were being built at the same time as the elegant arches of the choir. How could this be possible? How could the heavy Romanesque forms in the nave have been conceived at the same time as the light audacity of the Gothic choir?

I believe the problem is largely of our own making: those mental concepts of ours which define the differences between Romanesque and Gothic have created our difficulties because they impose on the building definitions of hindsight like 'archaic' or 'futuristic'. We need to be wary of these concepts for they limit the past. If we are not careful the definitions begin to write the history. To read this building properly the stones must be allowed to tell their own story with as little distortion as possible.

In seeking the cause for the differences between the nave and the choir we could begin with the lowest courses of the cathedral where the sanctuary buttresses were squashed and shifted until some became almost half the size of those in the nave. As the work rose they were surrepticiously enlarged so that above the triforium their width was almost the same as the nave's.[1] The real difference between them began in 1216 when Ruby reduced the width of the flyer arch from the 2^{PM} Scarlet had used in the nave of his 2^{EF}. Yet even that need not have had too great an effect if later masters had not treated the spokes differently, nor raised the height of the upper arches. The consequence was that the choir looks a lot less heavy, yet as we shall see the differences are more apparent than real.

To understand this zone we must start with the links between the flyers and other parts of the building. In the east the lowest flyer meets the apsidal towers in the middle of the vault over its triforium room.[2] The next arch bonds into the tower piers about half way up, and the topmost one starts just below the arches round the tower roof. So by extracting the teams from each level of the towers and by extending them into the flyers we can begin to unravel the eastern clerestory.

Elsewhere round the choir the middle arch continues past its support to the outside where it rests on the buttresses of the perimeter. The masters working there can be extended into the clerestory in the same way.

In the bay nearest the transepts the continuation of the arch meets the transept towers. On the south this binds the tower into the choir whose vaults could not be completed until the rooms under the tower had been finished. The interlocking web of arches which cross over one another in these corners is hard to visualise. Imagine

PHOTO 434: The interesecting flyers between the eastern side of the north transept on the left, and the north side of the choir on the right.

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[1] At triforium level the buttresses in the east are only a little smaller than in the west - 1,252mm. v. 1,618mm. - while ES.III under the tower is almost that of the nave at 1,568mm., and those round the apsidal stairs are larger. The apse buttresses by Cobalt are a lot smaller at 998mm. For the sizes at ground level see GEOM:V-B and VIII:33, and for the enlargements above the aisle walkway see GEOM:X-C.

[2] See note 30 and PHOTO:450.

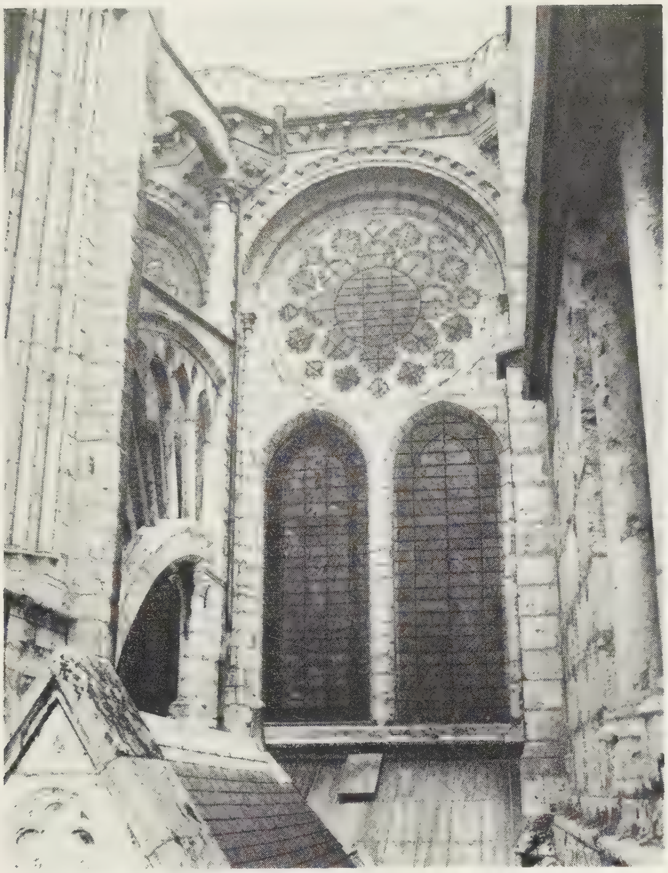
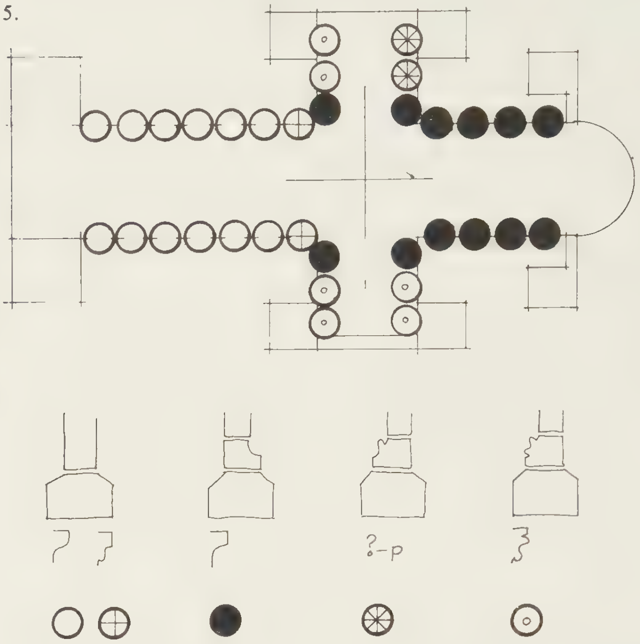


PHOTO 436: A typical clerestory window, with twin lancets like their contemporaries at Soisson and Dourdan. The mullion is built of coursed masonry like a wall. The rose window framed by a round arch is found nowhere else around Paris at this time.

two systems set at right angles to each other both sharing a common central support.[3] Through these arches the western end of the choir is linked with the SE tower and with the first bay of the transepts. The stonework shows clearly that there was no way of constructing the choir flyers without at the same time setting out and building the SE tower: which is further evidence that the south façade was substantially built with the rest of the work. As the SE tower is connected across its face with the SW, and through that to the walkway round the nave, we can relate much of the work in the choir to the nave.

Even though the towers in the north were delayed they still had to extend the buttress in the corner of the NE tower to support the outer arch from the choir[4]. Hence

5.



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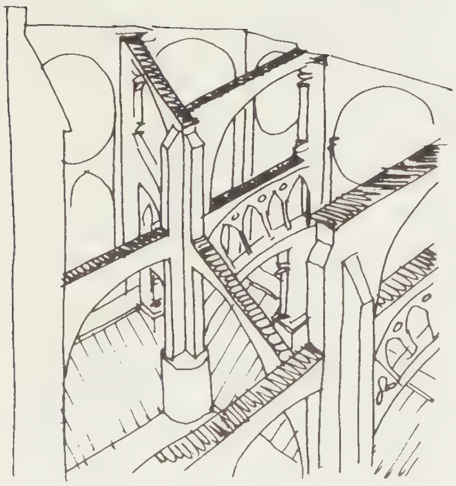

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3. Also see PHOTO:16.

4. XVII:27 and text.

5. The different shaped frames around the roses indicate the crews who worked on them. They are in most cases assigned to the crew most likely to have done it from the general flow of the work as there is no comparable detailing elsewhere, though the sections used are not inconsistent with their other mouldings. The four sections show how the plate tracery of the roses meets a circular frame, cut from one stone in the nave, and from two elsewhere. The different heights in the nave and in the choir are discussed in GEOM:XIX-B.

All the roses are cut from eight stones except in the nave where they are cut from 16. The smallest rose in bay I is also eight stones which is why I gave the rose (but not the frame) to the next master, Ruby. I cannot discern any differences in the detailing of these openings, and I have not had the opportunity to measure them. See n.6.

6. The larger circle represents the pier, often with different conditions on each side of the flyer arch. The smaller circle is the mullion. The letters outside the building refer to the types of seating used for the springing, while the interior letters refer to the campaign in which the work was done.

Some of the lancet arches grow out of a flat base with separate voussoires for each arch; some start above a common stone with angled seating for the arch stones; and some have a projecting upstand. These attributions are consistent with these team's other work in the crypt in VI:17/**d**, the sanctuary in X:43, and in the transepts - X:48 and XV:40/h. Notice Olive's unique springers in the north with a 'cover plate' over the bottom joint, and Cobalt's projections in 'f' - XV:40/h and XVII:32/a. To see how this drawing applies in practice refer to the clerestory elevations in n.76.

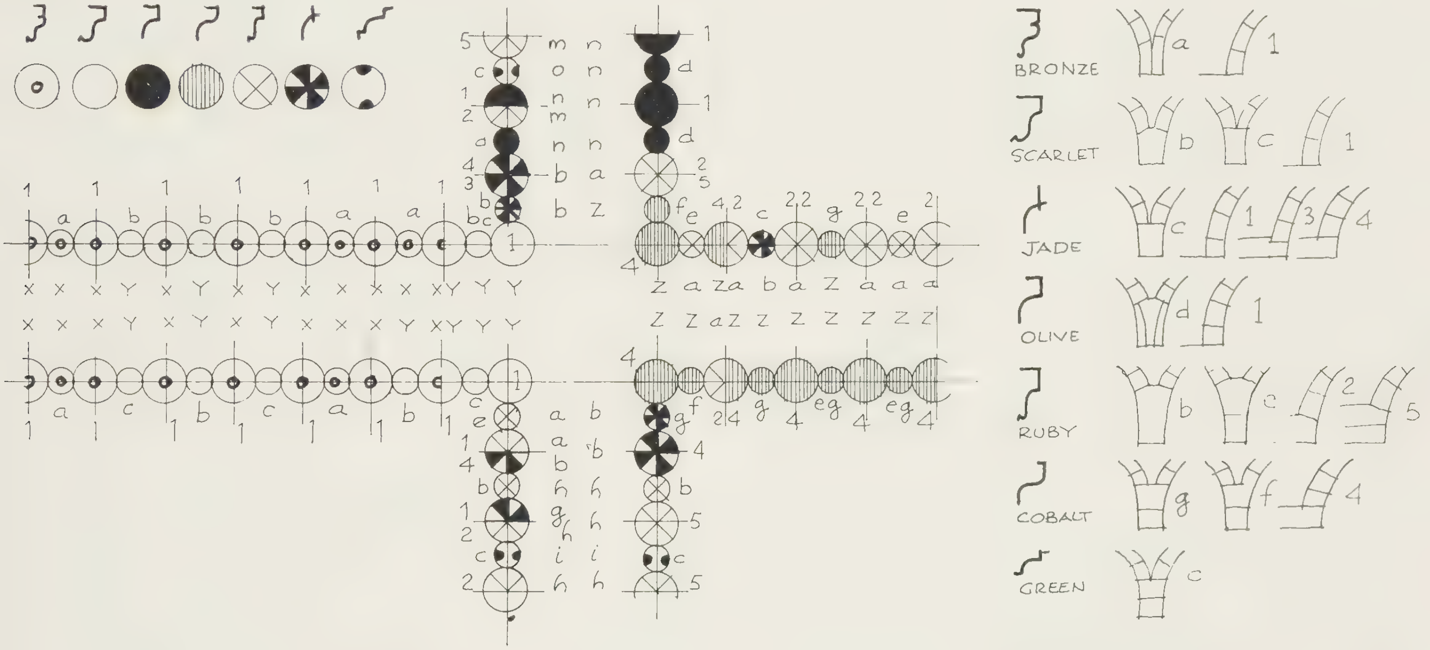
Cobalt and Jade maintained a constant height for the springing of the lancets which matched the top of the *tas de charge*. Consequently in the wider bays of the transepts where the rose is larger the cornice above them has been pushed up. They intended to make their adjustments in the vaulting cells, not in the lancets.

Bronze fixed the height of the lancets so that the top of the roses would be level right across there are connections between all six towers and the flyers. The crews who were finishing the choir were working at the same time in the northern tower rooms at triforium level, and in higher levels in the apsidal and southern towers. Within these clear and firm connections there are a host of small details which indicate where the joints occur and help to identify their creators.

The fact that the nave was more advanced than the choir ensured that each of the major parts - spoke arrangement, buttress shape, the ostiums and aedicules, the pinnacles, setbacks and so on - would be determined by different crews at each end. However there are strong links in elements like the bases and capitals, the carved leaves and crockets, cornice silhouettes and so on which connect with earlier work by our crews, and there are changes in the patterns around standard elements which will also help. The moulding which surrounds the roses of the clerestory is an example of the latter.[5] These mouldings show that nearly the whole of the nave was put up at the one time, and separately the whole of the choir. It also shows the most important fact that the first bays in the transepts were erected with the choir, including those on the western sides adjoining the nave.

There is a similar pattern in the arches of the lancets just under these roses,[6] and also in the cornices. Rose's cornices, for example, are the same shape no matter where they appear on the job, showing he carried a standard templet with him from place to place.[7] In

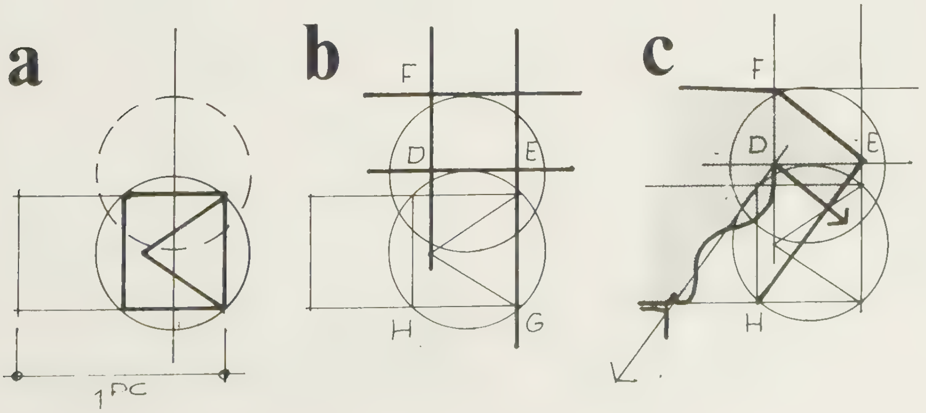
6.



the job. Hence in the smaller bays with smaller roses the lancets were set higher up.

Scarlet in WN.I and WS.I kept his springing at the same height as in the adjoining bay, and was prepared to squeeze the circle of the rose into an ellipse. This was not an acceptable solution to Cobalt who inserted a tapering ring of stones to bring the ellipse into a circle, as can be seen in n.76. The rose was consequently not going to be as high, and so it also had to be raised by this ring to bring it to the same height as the others. This is why the wall between the lancets and this rose is larger here than anywhere else.

Notice in the end bays of the transepts in XX:9 and 32 that the central mullion under the lancets was later than the work in the facades, presumably because cranes were delivering materials through here. It was not only easier to take materials for the inside of the facade this way, but it avoided the difficulty of building scaffolding over the porch roofs. The situation is the same as in the NE room -XVII:22. Refer to crane positions XIII:32.



7. The construction of Rose's cornice is based on the square of his half-foot and the circle and triangle which stem from it, drawn in **a**. In **b** the heavy lines derived from this figure locate the corners of the cornice: DF comes from the triangle, DE from the circle, while both EG and GH are from the square. In **c** join F to E for the top of the splay, and draw its underside parallel to this from D. Secondly join E to H for the edge of the drip, and draw the line parallel to that again from D to locate the wall under the cornice. The curves underneath are then filled in. The height of the stone against the window sill, within which the slope of the walkway was cut to F, could have come from √5 of the square. His cornices in the triforium are the same - XIII:44.

chapter XIII we showed how Rose's cornices often had tumours on them which covered lumps of flint buried within the limestone. Rather than cut them out and leave a hole in the stone he preferred the lump. They are to be found on his corbels, arches and cornices.[8] Through them we can link his cornices in the choir clerestory walkway with others over the perimeter buttresses. The cornices in the nave do not have any tumours, and though they are similar in shape, they can be shown to follow a different geometry.[9] It was convenient to assign the nave to Ruby[10] as the section shows that his corbels over the top of the triforium passage lie just underneath.[11]

So, here in the one campaign Ruby fixed the height of the triforium passage and its upper string course Q, the clerestory cornice and the first stones of the sill itself.[12] This included fixing the shape of the lancet windows. He was responsible for the plan and the heights of this zone of the clerestory. It was a very important campaign.

He could have placed the walkway on the inside of the glass as in many Burgundian and Norman churches, or he could have left it out altogether. The range of possible choices is as wide as the entire available architectural repertoire, for at that level the walls were thick enough to allow for any solution.[13] I have long puzzled over the fact that in the southern nave the natural order of the work suggests that the courses laid by Ruby could have been done earlier by Olive. But there is little sign of him. In the rooms under the western end of the roof lie Bronze-O's corbels, followed by Scarlet-P's splendid ashlar, but above that very little that could be given to Olive - few of his mason's marks and few of those long, thin and poorly edged stones which identified him elsewhere.

It is as if he was prevented from proceeding with this wall, while still pushing on with the north and the eastern side of the nave, and the choir. Had he submitted a proposal for the clerestory which the clergy did not like? Had the Chapter, now that they had resolved the problem of the sculpture in the Job doorway, decided to have a competition for the upper part of the cathedral? It looks as if they had asked for ideas, perhaps from a number of master's and had rejected Olive's.[14] This would have prevented him from working in the next zone, leaving it to the successful competitor Ruby, unless of course, some other master had designed these great windows but was unable at that time to execute them himself, being busy elsewhere. The new scheme may have been presented as a drawing, or even as a model, retained by the Chapter and, as with the presentation drawings for the cathedral made in 1194, was imposed on all the contractors to the completion of the last windows in the north transept some thirty years later, long after this design was *demode*. It would also explain Rose's exact continuation of the nave arrangement in the east. His walkway is precisely the same height as the one in the nave, though the pier is a little smaller, the windows larger, and the wall not quite so thick.[15]

It would not have been easy for them to fix these heights so well. If they had to measure them from the ground, they would have had to break through the temporary roof each time they needed to check out a level. If they had been measured from the triforium floor any errors there would have been compounded further up. If they had been read horizontally from the west they would have had to maintain their accuracy over the entire 100 meter length of the building, circumventing scaffolding, partly erected paving, and all the other paraphenalia of a job in progress. Neither way would have been easy, least of all without accurate dumpy levels, steel tapes and the rest of our modern tools. The accuracy they achieved should remind us of the difficulties they had to surmount.[16]

Building walkways round the outside of the windows was a fairly new idea in France, though internal ones had been common for at least a century.[17] In either situation the walkway is a builder's device installed to facilitate access for workmen and supplies and, after construction for the maintenance of the stonework and the glass. There are only a few churches with walkways round the aisles, but the majority have them at the clerestory level. An inside passage created deep reveals which confirmed the weight of the building in no uncertain manner.[18] But by moving them to the outside the glass was brought in

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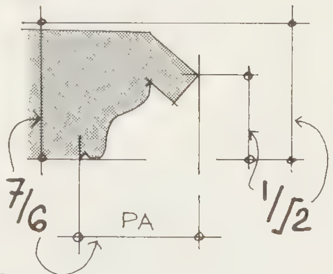
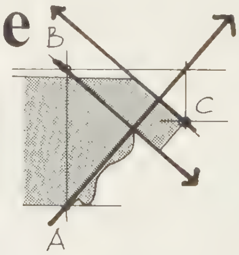
[8] Tumours are the work of the Rose/Ruby group only. There are 17 of them, and occur only after 1211.

(t) a. By SE.III-S door - XIII:7/n.
b. in SE.II corbel - XIII:18/f.
c. by drain in NE.II room - XII:41/h.
(t+) d. ES.IV cornice - XIII:44.

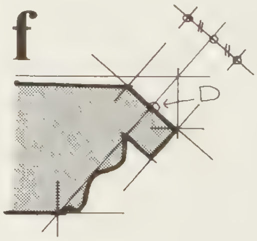
d

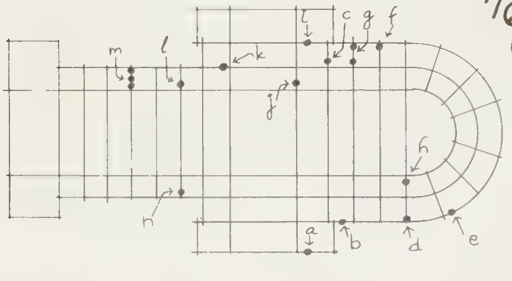


e



f





e. ES.VI - XIII:44.
f. E.VI ”
g. EN.II ”
(cw) h. ES.IV conice -n.10.
i. NE.I ”
j• in mullion NE.I - XX:9
k. NW.I corbel - n.29.

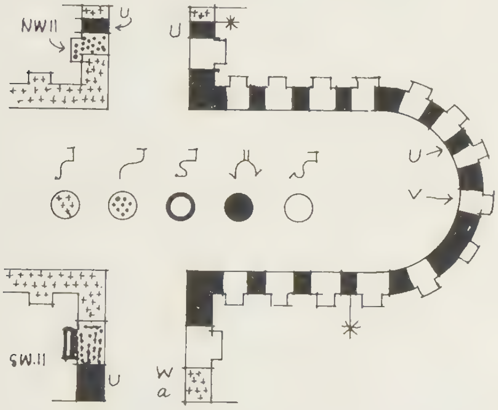
(Flyers) l. second arch WN.II - n.49
m. second arch WN.IV - n.49
n. second arch WS.II - n.49

[9] Ruby's cornice is rather like Rose's except for the slope of the drip and the walkway surface. His walkway falls 21mm compared to

Rose's 10mm plus. I found that his geometry began from the size of the original stone before the upper part had been shaved down to form the fall.

Begin with the EF of 12″, form a 6:7 rectangle and a proportion of 1:√2 on the right of **d**. Draw the line from A to the far corner in **e**, and at right angles to that draw the lines from B and C which form the drip itself. In **f** fix the length of the slope as equidistant to the drip around D. From this mark the walkway surface, and the undermould from his standard corbel templet. Compare this with his sill VI:55. For the changes in his cornice outline over the years see IX:33.

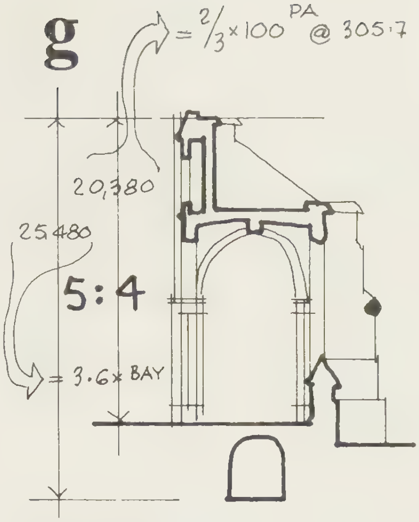
10. *The clerestory walkway*
The walkway is stone C in n.11, and it can be divided up by following the changes to the shape. The most obvious are in the choir where the black ones have a sloping drip measuring 185mm, compared to the white which are 32mm more. They are Rose and Scarlet with tumours in two of the former's marked with *. The attributions under NW.II and SW.II are uncertain, though when the alternatives are co-ordinated with the next course and with the corbels over the triforium passage underneath, the choice is not great - n.21 and XII:32/VI.



The end bays are Rose-U and Ruby-W in the south, with perhaps the last stone being by Ruby-a - XIII:3 and XIV:29 - and in the north Rose-U - XII:32/IV, and XX:9 where the attributions can be checked against the work in the walls of the towers and their rooms.

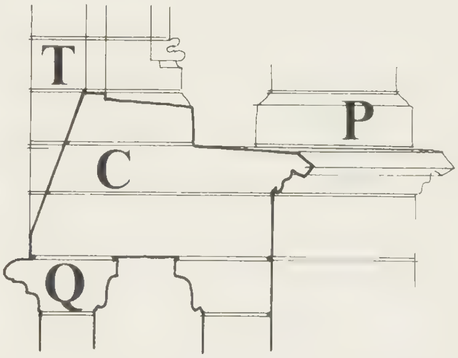
Ruby's cornice is described in n.9, Scarlet's in XIII:45 and Rose's in n.7. The others cannot be analysed with any security as there are not enough examples to average. I found that without averaging at least five examples the variations in cutting were too great to get an accurate geometry in something so small. However, I should admit that I was not able to make any sense out of them until I knew who laid what, and could then apply their foot units. These cornices are not markedly different. They all have an angled drip and a double roll mould underneath, yet they are still sufficiently different to show that the geometry of one cannot be applied to another.

There is one other item: Cobalt's drips do not have a 90° angle at the leading edge, but one between 97-100°, as in the apse (a) - X:12. The outer stones in SW.II and NW.II are replacements, though they could have followed the original shapes.

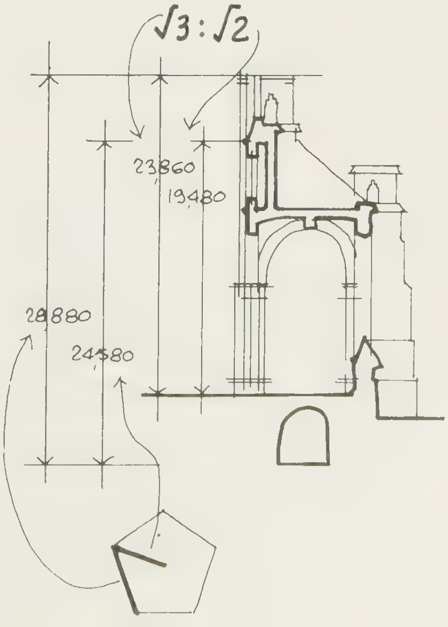


Ruby established the heights of the cornice as two thirds of 100^{EF} above the floor level. It also works exactly 4:5 to the floor of the crypt **g**. See GEOM:XVIII-E.

11.



12. See n.21. Q is 15^{EF} above the string he placed under the triforium, making his internal division 49′ and 64′ above the floor. The sill is 68′ up, compared to his 16′ in the aisles. In the choir Rose set this string course 100mm. lower so that its centre produced this arrangement with his springing. For the springing itself see GEOM:XVIII-E.



13. The same applies to the heights, for in the rooms over the aisles Scarlet had finished the top of the cross-walls at a steeper angle than the present room. Though it is stepped it seems to point to a walkway about 700mm higher than the present one. This would have fixed it at a height of 3 bays from the paving, or 21,180mm, or perhaps 5/8ths the span to the crypt floor. See further possibilities at the end of GEOM:XVIII-E. Ruby's height is 20,380mm or two thirds of 100^{EF}. Compare this with the height he established for the outside walkway in 1206 of 50^{EF} - GEOM:XI-C - which is also the width of the nave between the clerestory buttress shafts - GEOM: XVIII-B.

14. In other jobs he preferred to place his passage on the inside of the glass. At Essomes the transept aisle windows lie behind an internal walkway that has Olive's corbels above and below it. Its details are a model for those at Reims where Olive's corbels lie over the opening in the piers. See chapter XXII. Olive did work in the nave for some of these walls have his marks - II:19.

15. Compare the different plans of nave and choir in GEOM:XVIII-C and D. The recesses carved on the inside of the sills determine the widths of the windows, showing they were begun in the course above the triforium passage corbels. The wall thickness in the east could have been determined by Scarlet?

16. The levels do not vary by more than 20mm on either side of 30,390mm above datum, except in the south transept where the level was reduced about 50mm, and in the north nave which is 100mm higher. The north triforium is also higher than the rest of the building by 80mm, as are the footings under the north nave piers. Above, the vault spring is 90mm higher on the north, and so is the roof cornice - XIX:10. The reasons are discussed in VII:24.

I think that vertical measurements were taken separately in each zone, and possibly once the temporary roof was in, cumulatively level by level. Either they did not check across the site, or it was more important to maintain the elevations intact and the same on each side, irrespective of their differences across the space.

17. Miscalled the Remois passage as it occurs in the aisles of the cathedral of Reims - in the clerestory the passage is external. The use of an internal passage is a century older: in the Durham transepts of the 1120's if not before in Normandy. The transfer of the walkway to the outside came later. The ones in the Chartres sanctuary aisle of 1200 are the oldest I know. See n.14.

18. Bony, 1957-8, p.42 calls it "a play in depth which creates a sort of uncertainty in the definition of the limits of inner space", which is certainly true in the later examples transformed by the new spirit.

Geometry XVIII-A

Adustments for settlement.

Some parts of the cathedral may have been slowly squeezed, so that the heights we find today are less than those originally built. I first noticed in the next geometry that there was a square across the nave establishing the T centres. Careful measurement showed that the horizontal distance TT was less than the vertical from the footings to the walkway, 20,420 v. 20,380. The former fitted snugly into all its allied horizontal dimensions, so the shorter vertical measurement suggested that the building had settled, not in relation to its foundations from which all dimensions had been taken, but in the wall.

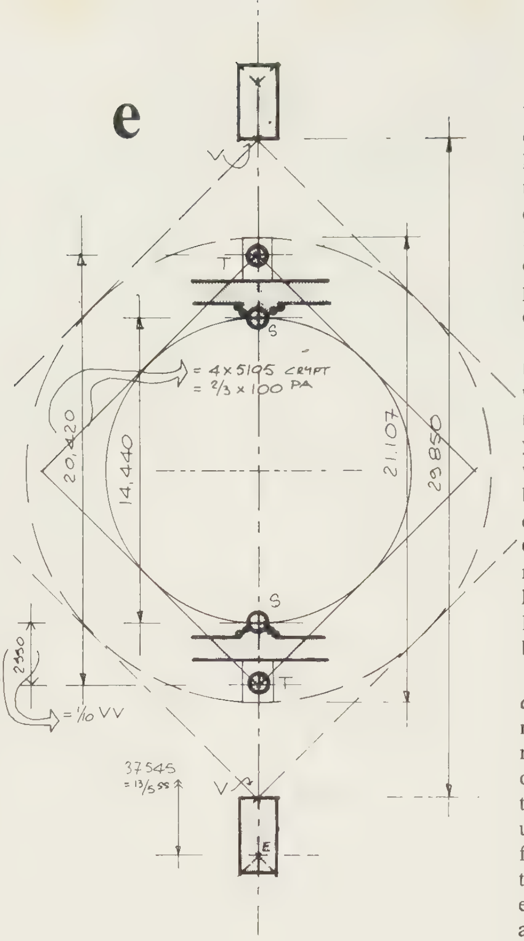
Some care had to be exercised in checking this out, for the ratios found between different parts vertically would not alter if all parts of the building had settled uniformly. Similarly with the plan dimensions. Settlement would show up only when we compared one with the other.

In XII:31 if the height of the passage had been placed at 49^{EF} then it had settled 15mm. Similarly in the arcade piers in GEOM:XI-A the ideal in the plan are a little less than the actual, suggesting that the original height for the piers may have been closer to 9,250 than 9,230mm.

In **h** in the next geometry the horizontal dimension between the buttresses EE is 18,800 x 2, while the vertical relating to it is only 18,770, a settlement of 30mm.

On the other hand in XII:6 and XI:20 the height of the external cornice was found to be precisely three times the crypt height. Other evidence seems to confirm that there was little if no settlement in the thick external walls, but only over the arcade piers. It is not easy to establish how much, but it may be in the order of 30mm in 20 meters, or 15 parts in 10,000. This could not occur in the stones themselves, but in the mortar of the joints. There are some 60 courses in 20 meters, averaging 6mm thick. The shrinkage per joint would thus be 8%, which may not be unreasonable in highly loaded situations over a slender construction.

In XII:24 I suggested that the underside of the footings for the triforium cross walls may have been one of the elements used by Bronze for establishing the heights of the main vaults. The nave height may have been 14,675mm from the footings. Adding the crypt dimension to this and doubling it produces 39,545. But the underside of the present nave ribs are 100mm less than that. This suggests that besides the overall settlement in the walls of 40-60mm, there was a settlement in the vaults of another 50-60mm, maybe more, on top of that. Adjustments will be made in later geometries for some of these movements.



Geometry XVIII-B

The axes in the nave and choir clerestory, Ruby-R and W, 1211 and 1216.

The vertical dimensions of a medieval building should normally be assumed to originate in those of the plan, as there is no practical way to carry out a geometric setting out in the air. This is why verticals were derived from modules found in the plan.

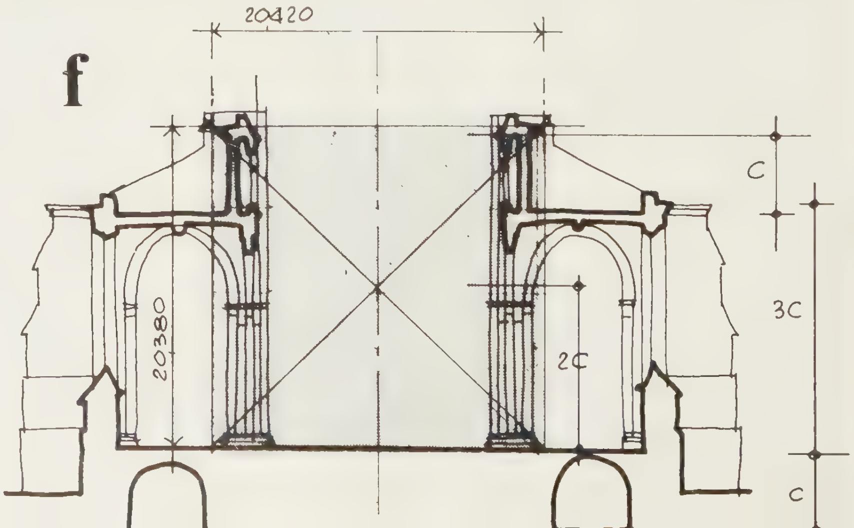
If we accept the view that the triforium zone is not just the roof space over the aisles, but is also the base of the clerestory, then the hollowness of its arcade would have 'read' in the master's mind like the hollow of the crypt under the cathedral, as their heights are almost equal. 5,095mm is precisely one sixth of a hundred Ruby feet. He used the module many times, in the exterior walkways, in the clerestory walkway, and in the arc of the flyers. In **f** it is the height of the crypt, and also of the cross-wall footing to the top of the triforium passage; marked also in the extreme dimensions of the two string courses.

When Ruby set out the external walkway in the triforium in 1206 he began the inner face of the perimeter buttresses, but as he did not lay the plinths he did not locate the outer face. Five years later when he placed the clerestory walkway in the nave these plinths had still not been placed, so he was presumably still designing for the buttresses discussed in GEOMS:XI-C and XII-A. These plinths were not put in until 1213, by Cobalt and Red. So I looked for a geometry that would link all of Ruby's centres, ignoring the elements installed by other men.

The shaft S in **e** lies over that of the *pilier cantonné* and was in the first place set in relation to the main axes by the fifths and ninths in GEOM:V-A. The position of the outside shaft T was implied when Ruby built the buttresses over the triforium cross walls under the walkway. When he placed the plinths for these buttresses in the choir he completed the scheme he had begun in the nave five years earlier (though the nave plinths were Cobalt's, and the choir wall Scarlet's). T was located in relation to S *ad quadratum*. The same geometry was used to relate the face of the wall outside T to the inside face of the perimeter buttress V, and is shown dotted. One tenth of the space VV is almost equal to ST.

The organisation of ST is the same in the choir, showing that the longer span of the flyers over the double aisles of the sanctuary had nothing to do with the placement of T. It seems to be just the necessary construction for stabilising a wall laterally. Below the walkway the nave is Ruby's work and the choir is Rose's, and the same structural goemetry has been used by both, tempting me even more to call them cousins.

This geometry may have evolved from one Romanesque technique for calculating the thickness of walls in simple structures. In the nave of the small church at Iffley, Oxfordshire, for example, the square was placed within the



nave, and the circle around it located the outside of the walls. The walls at Iffley are solid, without internal shafts or external buttresses, except at the corners. But at Chartres where the same technique has been used to locate S and T, two momentous changes have taken place - the geometry has been calculated to the centres of the applied shafts rather than to the wallface, and the actual structure has been reduced to a thin shell between the thickened sections which derived from the square and the circle. The structural evolution of Gothic from Romanesque can be summarised in these steps, which replaced the wall mass with axes, and then re-arranged the masses around the axes according to other logics. The complexity of Gothic compared to the simple wall and buttresses of Durham, seem to have evolved from the clear separation of functions, and the application of different rules to each function.

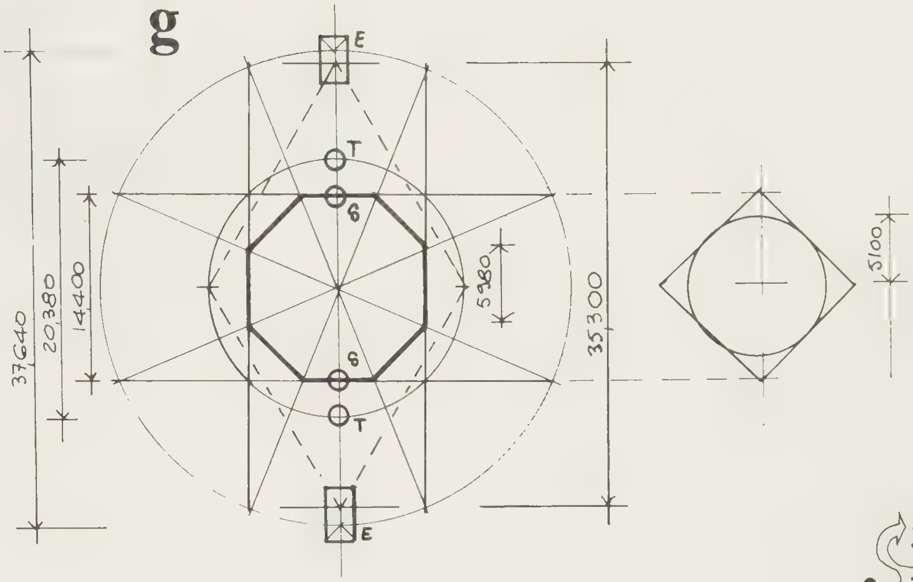
In the section **f** the height of the walkway forms a square with the width across the epicentres, shown shaded. The distance of 2,990mm from T to S is an important length. It is another oft-used module, and forms a pattern of its own across the building. It relates back to the divisions of the bay and to the distance between the arcade pier shafts in GEOM:VII-B/**t**. It is one tenth of the space between the inside faces of the buttresses VV, and is often found in Bronze's set out for the porches in GEOMS:III-C and XVI-B. It is invariably too large to have come from the Roman Foot. Its origin lies in the spaces left in the nave after all the structural parts had been evolved, discussed in ch.VII.

Using the squares in **e** the epicentres of the perimeter buttresses under Ruby's walkway can be located from the octagon star in **g**. It precisely binds into one figure the shafts, and the Ruby epicentres T and E. The side of the octagon is 5,960mm, which is double the 2,980 module just disucssed. The circle in the centre comes from the height of the crypt. This does not necessarily mean that in order to design the clerestory Ruby had to start with the circle of the crypt, for each could have been evolved separately, through small direct steps taken appropriately at each level. But because all come from the square they can be combined into the one figure at this level. Notice also how the 60° triangle defines the exterior walls of the nave at 35,300mm.

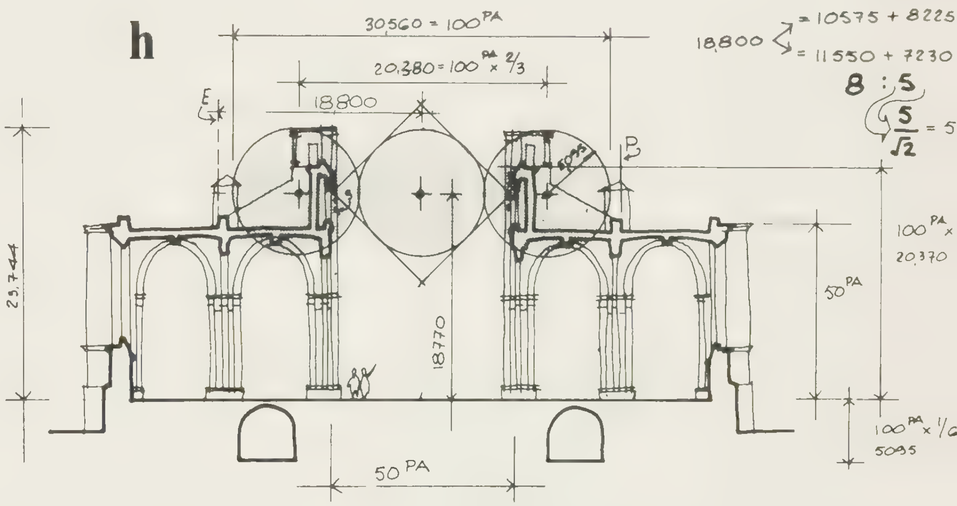
In the sanctuary the central pier under the flyers was located by Bronze - GEOM:XII-E. When Ruby came to place his arches on them the intrados lies somewhat within the pier. The arc of these arches has a radius of 5,090mm in **h**, which is also the height of the triforium in **f**. If we measure the overall space between the flyers across the choir it is precisely 100^{EF}! Well! This shows that the arc of the flyer arch creates a cluster of three circles, each one third of 100′, which links to other parts by Ruby, as in the 50′ space across the nave - XII:31 - and the height of the cornices - XI:20. See GEOM:XVIII-F.

The height of the centre of this circle is equal to the distance of the nave epicentre, marked E, and the middle of the nave. The consequence, using the ratios discussed in GEOM:XI-C, linking all these modules to the main axes, are shown to the right of **h**. The upper dimension of 23,744mm is the height of Ruby's vault springing in the choir.

g



h

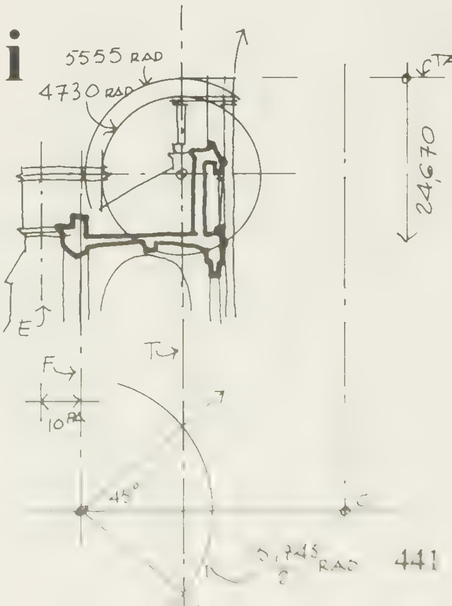


The radius of the flyer arch in the nave is smaller than the choir's at 4,730mm, taken from the same centre as the choir's, on the T axis. He had planned for this in the triforium when he located the inside face of the perimeter buttress, and in the clerestory with his wall-pier design. The geometry does not work to the underside of the arch, but to the top face, or extrados - see discussion at the end of GEOM:XVIII-E. This would have coincided with the F epicentre in GEOM:XII-A/**a**, following a radius of 5,555mm. The construction is shown in **i**. CF = 15,745mm, which is ten times the pier drum. CT = 10,180mm. The height of his extrados would then have been the same as Bronze's in the choir, 24,670mm, which follows a 4:3:2 ratio with the top of the choir clerestory wall: the extrados: the span (32,890:24,670:16,475mm).

Applying this idea to the choir flyer arch, the radius to the *tas* is 5,100mm plus the 3^{EF} of the arch, n.49, or 6,010mm. If we divide the distance between the middle of the choir and the centre of the central flyer pier, marked P in **h**, into 8 parts, 3 of them will give this radius, and 5 the shaft T, also being the centre of this arc.

...XI-D/XII-A & D/*....

i



line with the wall, and tended to become one with the plane of the stonework. This change coincided with the trend among many architects to disolve the weight of the walls, and to replace the massiveness of the Romanesque *parti* with a skeleton of shafts and ribs. This emphasised the movement within the building, and its luminous qualities, at the expense of its mass and their gravitational and more static forces.

The walkway must penetrate through the buttresses, so that openings are formed. As you can see in PHOTO:453 the outside of the buttress terminates in a column which represents an important point in the geometry. This point was so crucial that as the buttress itself was gradually pared away the shaft remained. In the decades after Chartres the buttress grew smaller and smaller until it disappeared altogether, leaving only the shaft. As the masters raised the height of the flyers the shaft grew taller, rising straight from the walkway to the underside of the arch, as at St. Pierre nearby.

Between the buttresses the sill forms a continuous strip supporting the double lancets, not unlike the scheme Bronze started in the sanctuary aisles. A thin shaft frames the windows on the outside. It continues up to the middle of the roses, and is a rather unusual arrangement for this time.[19] Most other contemporary windows are either single lights with a heavy moulding around them as at Laon or Braine, or they are doubled but without the shafts as at Soisson. The use of double lights was rare enough, but the use of outside responds was even rarer. Though there is no reason to place Chartres at the forefront of all creative and novel work in France, we certainly do find in it many of the most advanced concepts of the times. Both these ideas may belong to Ruby.

When you look along the edge of the nave walkway the outside edge of the sill seems to skip about with little rhyme or reason, yet on the inside the face of the wall is true. This means that every stone was cut to a taper so that the inside could be set along the straight line of the interior wallface, while the outside was bent back and forth. The faces of the piers in between were also twisted to give the zig-zag affect along the walkway. With some London students I made a detailed analysis of these bends.[20] These sills had been placed by two teams, Ruby and Cobalt.[21]

Geometry XVIII-C

The nave clerestory pier, Ruby-R, 1211

The only 'typical' bays in the clerestory are II, III and IV, and this analysis comes from the average of them. The nave was the design of Ruby, and though he did not place the outside plinths his walkway and sills indicate his intentions as I discussed in the previous geometry. The design for the pier consists of a series of blocks, built around the centre H and the wall faces. As shown in GEOM:XVIII-B he placd the outside shaft T at √2 times the span to S. This is drawn in **g** in the previous geometry. The H axis was then produced in **i** as modules of T and of the height of the crypt, that crucial dimension discussed in GEOM:XVIII-F. The proportion he used was the 11:14 which squares the circle, discussed in GEOM:VII-D.

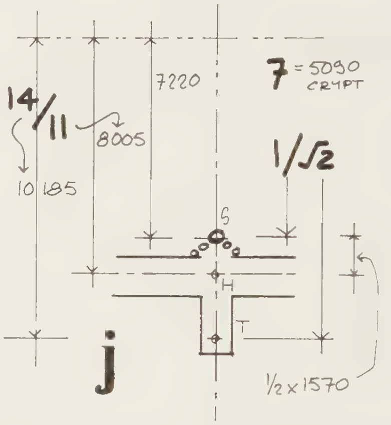
Once, S, H and T were located from **j**, he was able to position the inside face of the wall as half the distance betweeen S and H in **l**. If this sequence is correct, then the wall is not a primary surface from which volumes and proportions are created, and is not even a derivative of the real sizes of the shaft and the pier behind it, but is purely a convenience. It is a consequence of the theoretical axes taken through lines and points.

To represent real loads with points (which in geometry have no dimension) is an abstract concept far beyond the static thick-wall structures of nearly all previous cultures. The medieval way of using axes and point thrusts like this are indications of the new spirit which led western man to today's scientific achievements. It abstracts the essence of the problem from the gross, and was able to represent that essence in a general and mathematical way. The age of the formula had begun.

Ruby then placed the outside face of his wall 3′ from the inside, and the apex of the mullion A one third of that. He extended up from the triforium zone the 1,570mm box he had used in the piers from S to the wall L. This is shown shaded in **l**, and from it he proceeded to construct the pier and the window jambs. The centre of this box locates the line through the external responds D. Thus XD = ½ this box, but so does SH.

The next move was to draw the cirlce within this box, and the square within that in **m**. This located the width of the wall W between the responds. To fully locate D he needed to fix one more part: the wall-face U whose origin is shown in **e** in the previous interlude. The respond will fit into this corner, and its centre was positioned by C in one direction, and by the square between S and the outside wall-face W in the other shown shaded in **m**. This shaded square is reduced from the triforium square in **l** by precisely one sixth. It is no coincidence that the lower box should be repeated in the clerestory, nor that through its reduction we should obtain another square applicable to this level reduced from it by 5:6. After all, the triforium box is itself a reduction of the ninths used in the ground floor by 7:6, which shows that this may be just one more unit in a progressively reducing series of 7:6:5 (1,832: 1,570:1,305mm). Presumably there would have been a further reduction in this series higher up - see GEOM:XII-D.

Onto each side of the 1,570mm square he then added a half mullion, shown hatched on the right. From here a number of other ratios occur. The 1,110mm wall width at W when doubled gives the overall bulk of the pier, shown at the bottom of **m**. The real bulk of the wall XU, within which lie the roses and the lancets, is formed at the end of the process, and is secondary to the axes and the blocks.

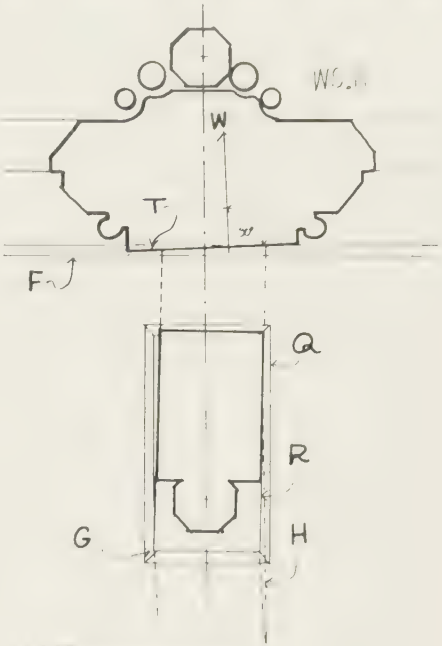


The space between the jambs left for the glass is 2,120mm, which is 3/10th of the bay. In **n** see how this forms a 3:1 ratio within the gap between the buttresses. also in dark outline it forms a square which locates the rebate one way, and the full mass of the wall from inside face of the shaft S to the outer face of the triforium wall L in the other. A small residue is left between this square and the window openings which is both glass and stone, where the 3/10ths do not apply. At the left see how these dimensions have between them formed the jamb.

One further consideration: the plane of the stained glass coincides with H. H represents the junction of the rib thrusts as the axial position within the wall into which all loads are gathered. The void of the glass may have been seen to have some relationship to this point. I presume, from Ruby's windows in the aisles designed 12 years earlier, where he made the window opening equal to the *pilier cantonné* in GEOM:VI-A, that there may be a similar

The twists in this section give the impression that these builders would not have been able to build a garden wall, and you wonder why the cathedral stands up at all. Some of these twists are large. At the torus level the WS.III passage which is only 700mm long, is 556mm wide on the west and 582mm on the east, and the splay over part of the plinth has been completely covered up by the torus in the next course which lurches over it. Further up the moulding over the flyer arch has been moved to one side as if the courses roundabout had been repeatedly hit with a sledgehammer.[22]

However, our survey showed that these troubled axes



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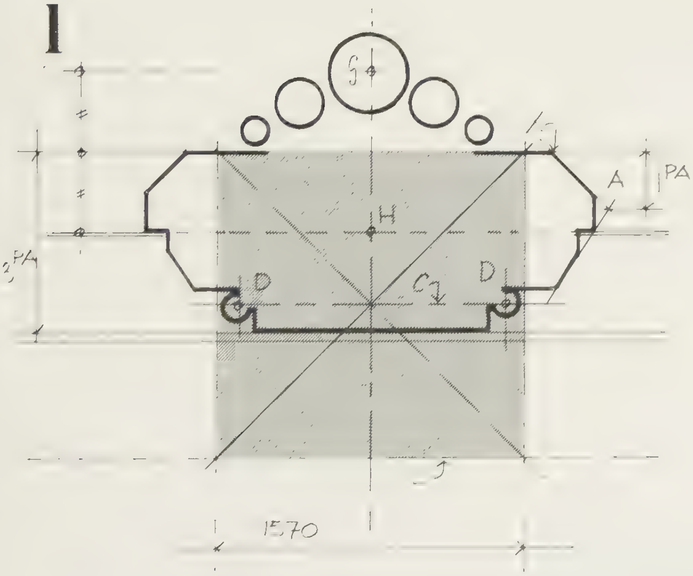

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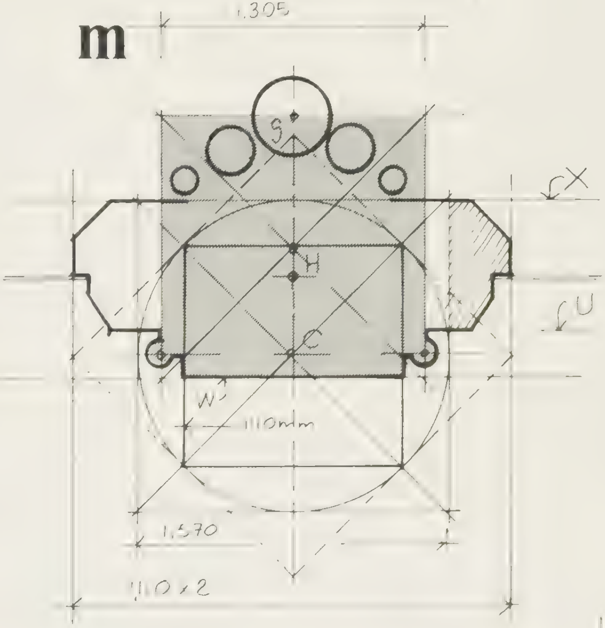

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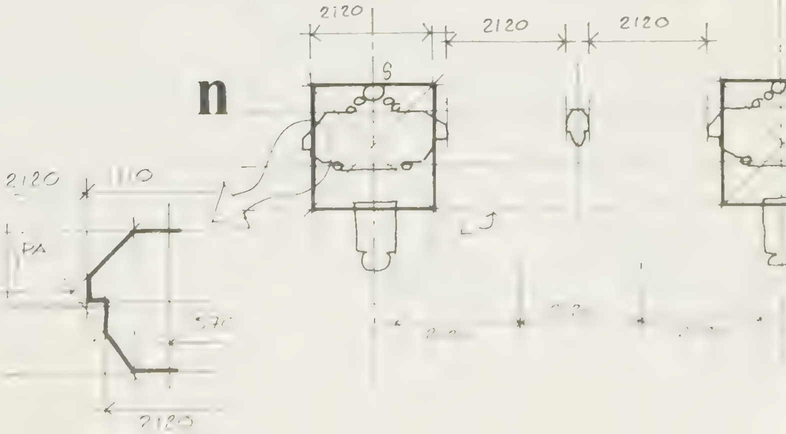


contrapuntal sense in this clerestory arrangement. For if the use of this centre H 'idealised' or 'abstracted' the many loads and forces into one point ('abstracts' because a point has no dimension, being without substance), and as Ruby related his glass line to that point, had he a sense of the weightlessness of glass as a luminous wall, also without substance? Scarlet, as will be seen in the next geometry, did not see it this way, for the centre of his glass relates to the pier mass.

...XII-D & G/*/XVIII-D...

19. See drawings in GEOM:XVIII-C and D, for nave and choir schemes.

20. Student working party from the Architectural Association School of Architecture organised by Dennis Sharp in the Spring of 1972, included Stephen Brown, Michael Crichlow, Patrick Thomas, David Tomkinson, Philip Wharmby and Peter Wylde. See GEOM:XII-H and n.21.

21. SEE NEXT PAGE.

22. The face of Ruby's plinth is marked F, and T is Cobalt's torus set square to the line taken to the centre of the WN.III buttress W. The plinth of the projecting buttress Q by Cobalt is placed square to the wall, but Red's torus course R is twisted again, forming a bend in the flyer arch itself at G. In the second row or voussoires at H this bend has been flattened out, and again in the next course with the spoke bases.

This is not the first time these twists appear at Chartres. In the piers and sills of the sanctuary aisle windows Ruby's are laid straight, but Cobalt's are twisted in exactly the same manner as in the clerestory. This was in 1203, see X:12. Bronze's sills, the first to be laid along the aisle walkway, are also twisted. I do not have enough work by each master to be able to determine the reasoning. Notice also that the aisle windows do not have the flanking shafts on the outside, though there are responds internally.

21. *The clerestory sills and plinths*

These courses are marked S and P in n.11. I began by analysing the angles of their splays and the different ways they treated the junction with the respond. I continued with any changes in alignment and the slope of the watershed. The axes were analysed after I had finished this analysis and they confirmed the divisions I had made here.

RUBY-R, 1211

a. Began the nave sill **h** with a splayed plinth under the pier which returns on the side, defining the base for the small shaft or respond which encases the window. The watershed has a slope of 1 in 25 with splays of 110 x 30°.

COBALT-S, 1212

b. All but one of the exterior nave plinths, to the same width as the wall underneath.

c. The rest of the nave sills with a steeper watershed of 1 in 15, and splays of 120 x 36° average. The outside face of his wall and his plinths are aligned on neither the triforium walls nor on the axes, but on the distant buttress on the other side of the nave. He had used the same technique in another place - GEOM:XII-H and XIII-B. From the twists caused by his alignments come all the irregularities in the setting out of the clerestory wall. WS.III & IV, and WN.IV are the exception - laid by Red?

d. All nave tori above the sills and the plinths. Above 'b' the changes in angles are obvious where one course overhangs the other, up to 25mm. I find some of the smaller misalignments between these two courses hard to explain, see 'h'.

RED-T, 1213

e. Short lengths of sill like 'c', but with a flatter watershed and splays of 102 x 35°.

ROSE-U, 1214

f. Sills to NW.I and SW.I piers have splays 110 x 35°. Unlike all the others they are held together with metal cramps let into the top surface. Hence they cannot be by the only other contender for these stones, Cobalt, as he did not tie his sills together with metal - XII:10/i. At SW.I the bases under the shafts may have been cut by Scarlet-V but laid later - n.23.

g. This crew was at the same time placing the corbels over the E(t) passage and laying some of the cornices - n.10.

SCARLET-V, 1215

h. All the sills in the east. The splay is carried no further on the sides than the edge of the torus in **i**. The splay measures 105 x 27.5° average. The watershed is steep, and slopes 1 in 4. On the inside he finishes against the glass with the same roll-mould as used in the nave asiles - n.25 and VI:73. He carved some of the tori over this course, but many are by Ruby, for his have been twisted over the straight ones laid by Scarlet. As in the nave Ruby has aligned the faces of his buttresses square to the axes across the choir, though his twists are not as extreme as Cobalt's.

i. Probably finished NW.II and SW.II bays after 'U', matching Rose's adjoining work without the roll mould.

RUBY-W, 1216

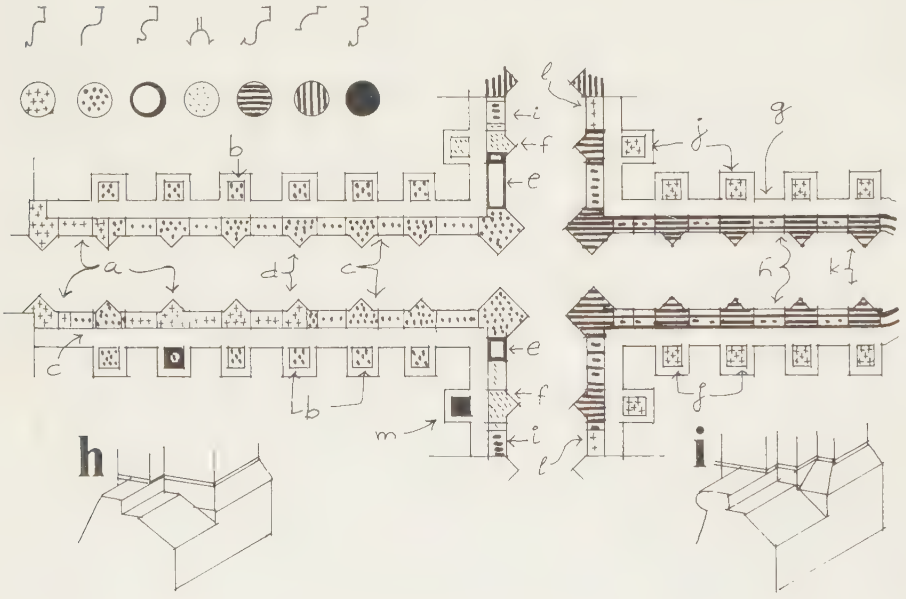
j. All exterior plinths to the east including the first bay of the transepts - 125 x 40° average with a smaller slope on the inside. All stones are placed in line to form a straight wall, so the choir has none of the misalignments found in the west. Sill under NE.I may have been placed by Bronze as there is a set-back by the crossing pier. The plinths must be Ruby as they are cut for a 2^{EF} wide flyer arch, unlike 'b'.

k. All remaining tori to walls and piers.

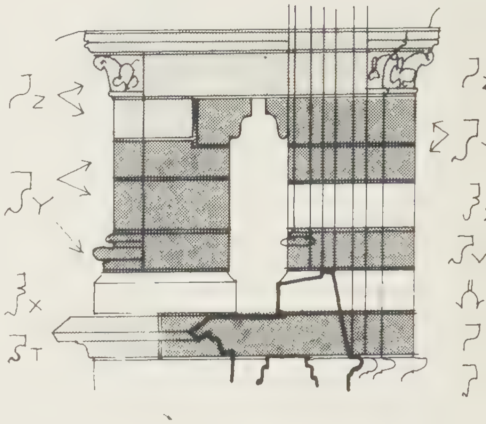
l. From XIV:29, using the same watershed as adjoining, but matching the rollmould begun by Scarlet. Sympathetic. See junction with the south tower in XIV:29.

BRONZE-X, 1217

m. From n.76 must be before Scarlet's torus course, and cannot be by Rose or Scarlet. Could be Bronze or Ruby-W - n.23.



23. The drawing shows the delay in this pier from Cobalt-S in 1212 to 1217. Five years of little work, in spite of a steady advance on the opposite NW.I pier and in the east. Reason may have been to do with gang-ways bringing materials from the crane.



24. For Scarlet's cornice above the perimeter triforium walkway see XIII:44 and 45. In the nave the cornices over this walkway are the same except for the western leg of WN.I which is Rose's. Hence Rose fixed its height, discussed in GEOM:XVIII-E. The moulding over this cornice is the same all round, being cut from a stone 462mm high, except over the WS.I corner buttress where it is 50mm smaller -which makes it 4 English palms by Ruby-W. This shows that the WN corner was more advanced than the WS, consistent with the tilt in the work at the clerestory level in the previous note.

25. Shown in n.21/**i**. They cannot be by Rose because of the joints in the cornice which separate the sill from Rose's corbels underneath - n.11 - and they cannot be by Ruby whose corbels lie over the walkway because of the joints between the pier plinths and the tori in the transepts. Hence the argument in VI:73. Another reason is that half the stones in the cornice course underneath are by Rose, and to have expected Scarlet to have laid only enough stones to finish the cornice without also doing something in the next course would not be consistent with the amount of work he did elsewhere. The roll moulds are continued down the eastern side of all three bays in the transepts. The first bay on each side are Scarlet's, and possibly the beginning of the next. Ruby continued them across the second bays, and into the third in the south in 1216 and 1220. In the north they were also continued by Ruby, but in 1227. Shows him to be a man of sympathy.

26. Compare drawings **h** and **i** in n.21.

27. The pattern is consistent on the west and east with all the nave square and all the choir scolloped, except for the capital over the SW.I which has bulbous crockets like SE.I - Green-I in XIX:10. See illustrations opposite.

had been deliberately placed. They were very carefully aligned to preserve an inner structural logic, even though the logic followed by one master may have been negated by the next. Ruby had placed the face of the plinth F square to the axis across the nave, while Cobalt had angled this face in T to line up with the centre of the buttress on the opposite northern side of the nave. Some of the torus courses R in the outer buttresses were placed by Red so that there is a bend in the flyer arch at G. Rose and Bronze who came later disagreed with both Red and one another on how to handle this bend when they laid the next courses over the arch, producing altogether five changes in the direction of this one element.

Thus the twists along the walkway began with the piers, not with the sills. But as the masters did not want a step in the plinth between the sill and the pier they formed the outer face of the sill by joining the corners of the nearby piers to create the present serpentine arrangement. The result is confusing, to say the least.

If Chartres had been set out with perfect regularity from the beginning without the eccentricities which give it so much of its appeal, I would not have been able to unearth these differences. No matter how varied the structural ideas of the master, each stone would have been laid precisely over the one below. For the sake of our understanding of their concepts we should be thankful that it is all just a little bit crazy.

Round the corner in the SW transept the inside torus has been pushed right over the sill. In one spot the corner hangs over the plinth, and its bottom corner has been knocked away.[23] The plinth was by Rose-U, and the torus was Scarlet's in the next year, cut for a perfectly square relationship between axis and buttress. I think it may have been left unplaced for a while, for not only is it twisted round to suit Bronze-X's later outer plinth, but in the process the inside of the stone was pushed over in a way I am sure neither intended. In plan this stone includes a curved recess on the inside designed to receive the *en delit* shafts which support the ribs. By twisting the stone after it had been cut Bronze got the inside curves out of alignment, so that when the shafts were inserted a little later they had to be tilted over. They are out of plumb, and though it cannot be sighted from underneath because the stringcourse gets in the way, it is distinctly visible from the triforium passage on the other side.

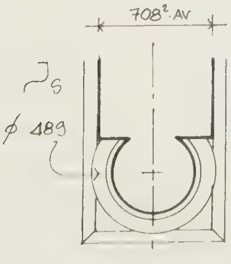
The master's approaches were not so antagonistic in the choir. Rose and Scarlet seem to have been more congenial companions for there are less discrepancies between them. However, the joints between their cornices stand out particularly clearly. Rose's drip measures 185mm along the slope and Scarlet's measures 212mm. This makes the top edge jump about at each joint. Scarlet's cornice is precisely the same as the one he used over the perimeter triforium walkway in both the nave and the choir, and in both palaces they lie over and after work by Rose, including his corbels. Rose followed by Scarlet at both ends of the building has helped link these two parts.[24]

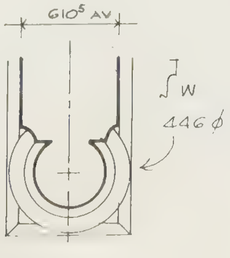
On the inside Scarlet finished his sills with the same roll mould used in the nave aisles fifteen years before.[25] Above that he set out the piers between the windows to a similar scheme to the nave, but with completely different detailing.[26] On the outside of the projecting buttress there is an attached shaft, and Ruby finished the corners of the pier backing it in a curved chamfer which seems to diminish its bulk, and to emphasise the shaft itself. compare it to the shaft in the nave which is much more solid - by Cobalt.[27] The arrangement of the grooves under the tori of the shafts, both alongside the sills and at the end of the buttresses, shows the masters working consistently with their other work, both in this zone and in earlier parts of the building.[28]

The unchanging details of these crews is quite intriguing. Here they are using many of the same details as they did in their first campaigns two decades ago, and as they will continue to use until the end of the job. Yet when we look at the whole of France we find that ideas were changing rapidly, ripening and fulfilling the promise of centuries of unparalleled invention and spacial discovery. But the changes were general, and did not apply at the same rate to the individuals concerned. We tend to think of creative men in the modern way where innovation is more important than conformity. But medieval men were pre-scientific and pre-industrial with more fixed and traditional ways of working than we are used to. Precept was more important than invention. Certainly men were changing, but it was happening within the firm and stable matrix of their older well-tried ideas which may not have altered for generations.

In time we may know more about this process, and be able to follow each new idea as it emerges from the minds of each master. I think we may then find that within each team there is a narrow current of change in which new ideas affect only certain aspects of their work. It seems as if the waters of invention flowed down only a few channels, wearing narrow paths through the harder material of tradition. We may find one master changing his ideas on one aspect while another changed his in some other, though small, way - like Bronze with his obsession with controlling water, and Scarlet's buttressing or Cobalt's delicate detailing.

Within these channels each master might introduce great changes, while the remainder of his work would stay where it was. Because the crews only spent a short





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[28] The grooves under the tori and the order of the work shows that most of the tori course in the projecting buttresses of the nave, and all those in the wall are by Cobalt, and all the buttress tori in the choir are Ruby's - with the exception of NW.I and SW.I which are Bronze, n.23.

time on each job ideas were mixed. They had to face up to other men's concepts, to analyse the older work and integrate their designs with it. Ruby with his rectangular buttresses had to lay stones over octagonal ones by Olive or Scarlet, and in time would have come to appreciate other men's methods even if he could not share them. Thus every master would have had first hand contact with all the motifs current in his day, and in time the more acceptable innovations would be absorbed into the tradition. Ideas begun in the aisle windows of the sanctuary gradually stuck until they became the common repertoire of France.

As with so many things, we need more information, for the changes seem to be individual and slow-moving. We will need to know who introduced each one, to be able to trace his ideas back to the first time he used it, and then to follow how they passed into the hands of others. We have this sort of information for the Renaissance and afterwards. Perhaps some day we may know it for the middle ages too.

There are corbels over all the openings of the walkway, from Rose in the nave to Ruby in the choir.[29] As can be seen in this section of the choir[30] the flyer arches connect the clerestory to the towers, and hence to the rest of the building. Once all the connections were clear, the crews taken out of the stairs and the towers could be applied throughout the clerestory without a hitch. Teams 'R-U' got the nave going, and 'U-W' began the choir. The difference between them is only three years. Three years to make such a staggering change in the two ends of the cathedral! So little for so much.

Once the sills were laid the temporary roof could have been raised from its lowly position over the aisles to the level of the clerestory walkway, and if it had been made strong enough it could have supported the centering above.[31] The new roof would have been finished by 1215 at the latest, providing a splendid high interior for the first time in twenty years, and a foretaste of the magnificence to come. No wonder the funds began to flow in once more about that time.[32]

From the level of the corbels over the walkway we have none of the classic items from which to find the crews, like windows, cornices, and so on. Though the last few chapters have given the list of contractors in the triforium, there are only a few places where we have certain connections to the clerestory. One is in the west against each of the old towers where there are rooms at roof level. They have no purpose, except one of them now acts as as a rudimentary toilet for the maintenance men. At the roof line of Fulbert's church, which was no taller than the roses,[33] the western towers began to step in, preparing for their spires at a level that was too low for the new building. As the new work was taller a gap was left that had to be closed.

The underside of the rooms is supported on three rows of corbels by Ruby-a which butt into the arches over the windows.[34] The wall above these corbels and the window in it all point to the work of Bronze. This wall is set

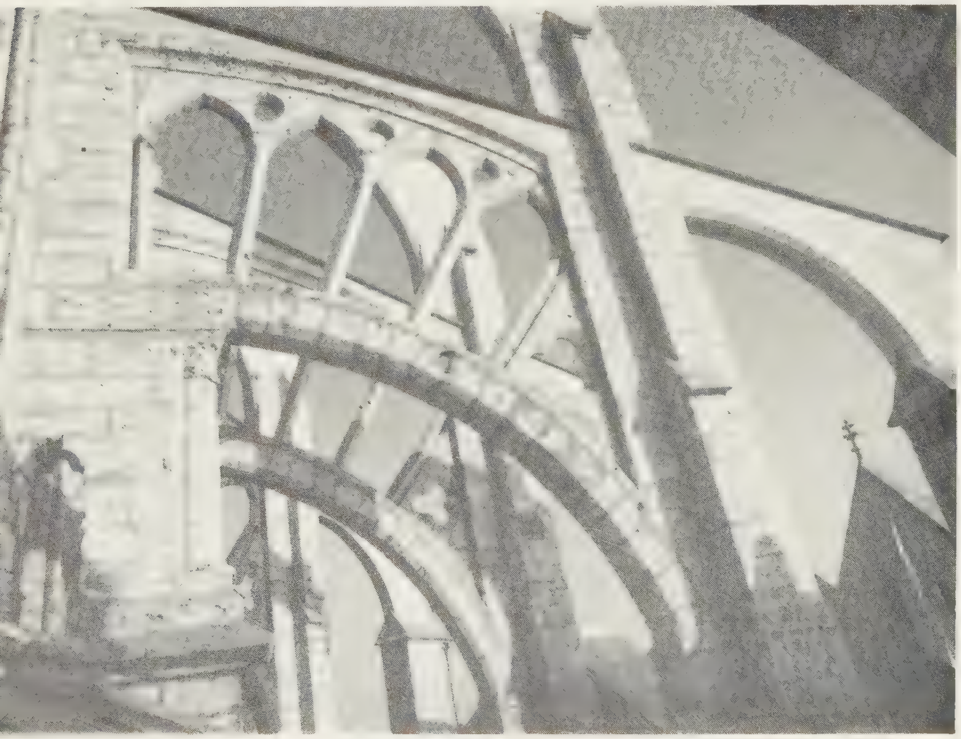
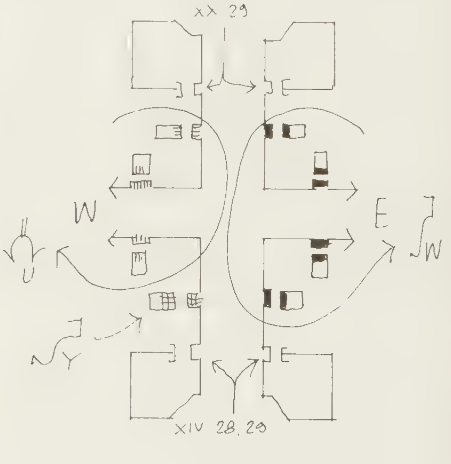


PHOTO 446: The elegant flyers of the apse which pass over the walkway around the windows. The corbels over the passage are by Ruby.

29. The drawing shows the arrangement of corbels over the clerestory walkway. Only the transept and adjacent bays have been included as all the nave is Rose and all the choir is Ruby. The latter are wider than Ruby's others, but the centre of the circle still lies directly under the plumb-cut. The corbels are bent around the corners more like those in the crypt chapels than those in the chapel (a) walkways - compare VI:17 and IX:33.



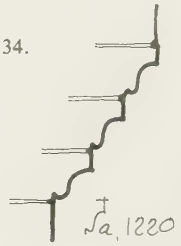
30. *Section through the choir clerestory and the ES tower.*
The references to notes are marked on the drawing. The gussets and spokes are shown being by crews who were not sufficiently advanced in the ES tower to have supported them, but in the more easterly flyers they were responsible for them. I give them their correct attribution here to avoid confusion.

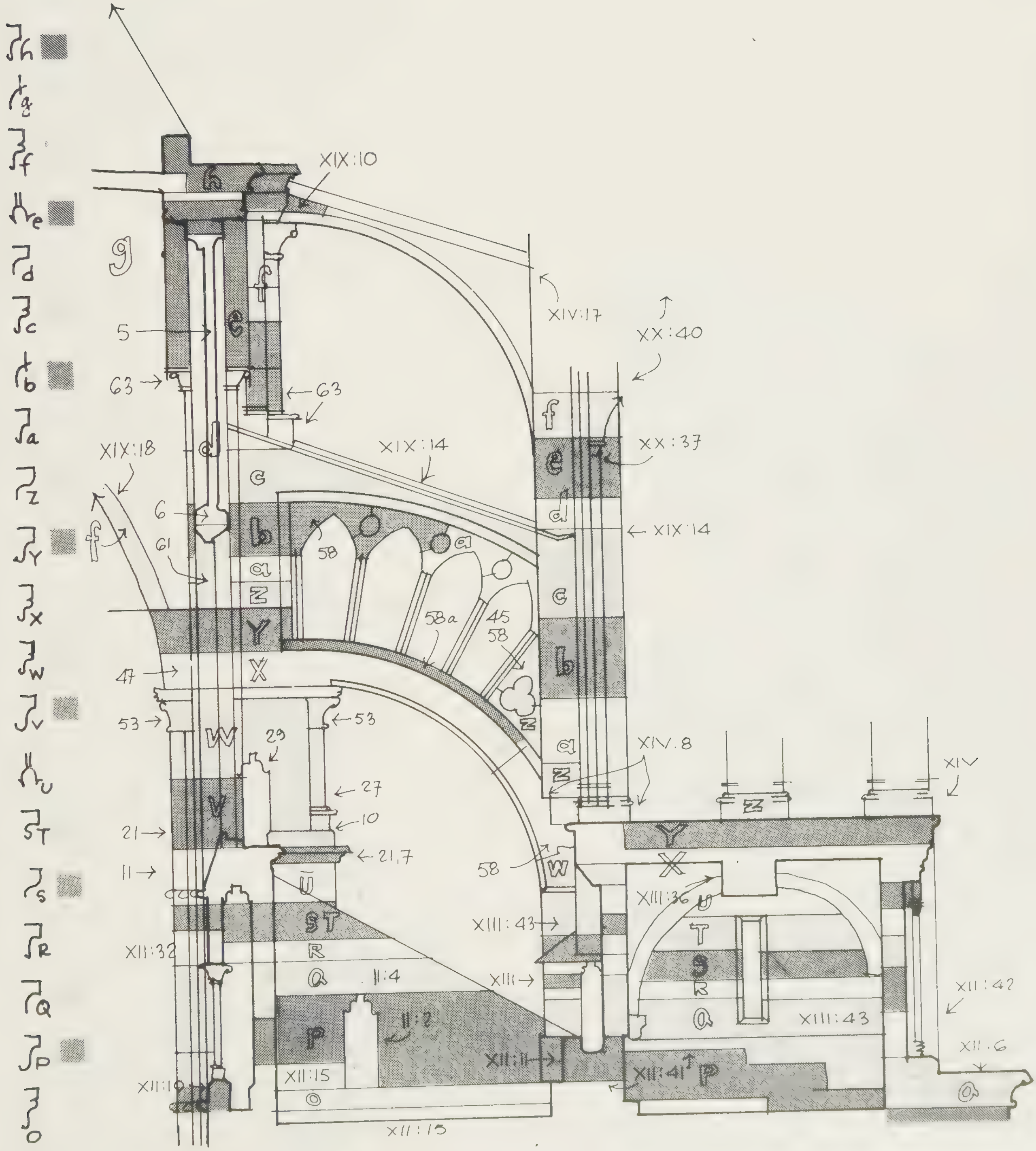
31. Fitchen, 1961 discusses the matter, see drawing II:11 and n.64. If it was finished by 1216 there would have been ample time for the design and construction of the wooden stalls in the choir which were finished and occupied in January 1221 - Lepinois and Merlet, 1862, ii, p.95-6. This text is discussed by Frankl, 1961, p.55-6, who also thinks they may have begun to build them as early as 1217. This suits the date I suggest for the *jubé* - XVI:40.

32. James, 1972(3), the chart on page 58, and also VI:45.

33. See XI:2.

34.





within an arch which reinforces it laterally.[35] It is not a device used anywhere else in the cathedral, but in the triforium at Reims there are similar arches set within the wall in the same way. The surrounding work shows that the arches at Reims could also have been by Bronze.

By the WN tower in **n** at the bottom of the rosettes over the rose there is a head by Bronze-*Oriental.* The course next to this continues from the nave to the room, passing over Ruby's corbels, but it stops part way across. The rest of the coursing is smaller, and the arch begins in the next course on the left. This shows a joint, for the block B was placed for a wall without an arch. Over the wall the cornice is continuous around the corner and is by Rose-e. The work on the nave is therefore bounded by Ruby-R at the beginning and by Rose-e at the roof: a period of thirteen programs for a height of about fifteen meters - which is much the same average rate of construction as we have found in other parts of the building. If the choir followed the same pace, and remained three programs behind the nave all the way, then the work there should have been carried out between Rose-U and Ruby-h.[36] All we have to do now is to isolate the joints in the two clerestories, and through the dossiers link them to the order of crews already dug out of the towers.

We are now face to face with the fundamental innovation of the period - the flying buttresses. About 1175 in Paris and St. Remi, Reims the buttressing arches within the galleries of the older churches were moved above their roofs to become exposed flyers,[37] "poised above the roof of the aisle, they took over the function of an internal gallery in absorbing the thrusts and bearing the weight of the high vaults of the church."[38] Chartres was the first building to be designed for them from the beginning, so that every decision made on the ground floor implied that the forces of the vaulting were to be ferried over the aisles to the outside walls. Whatever its real structural use, it was fundamentally an outcome of an aesthetic feeling that they wished to support the vaults on flyers rather than on thick walls. It seems to have been part of a

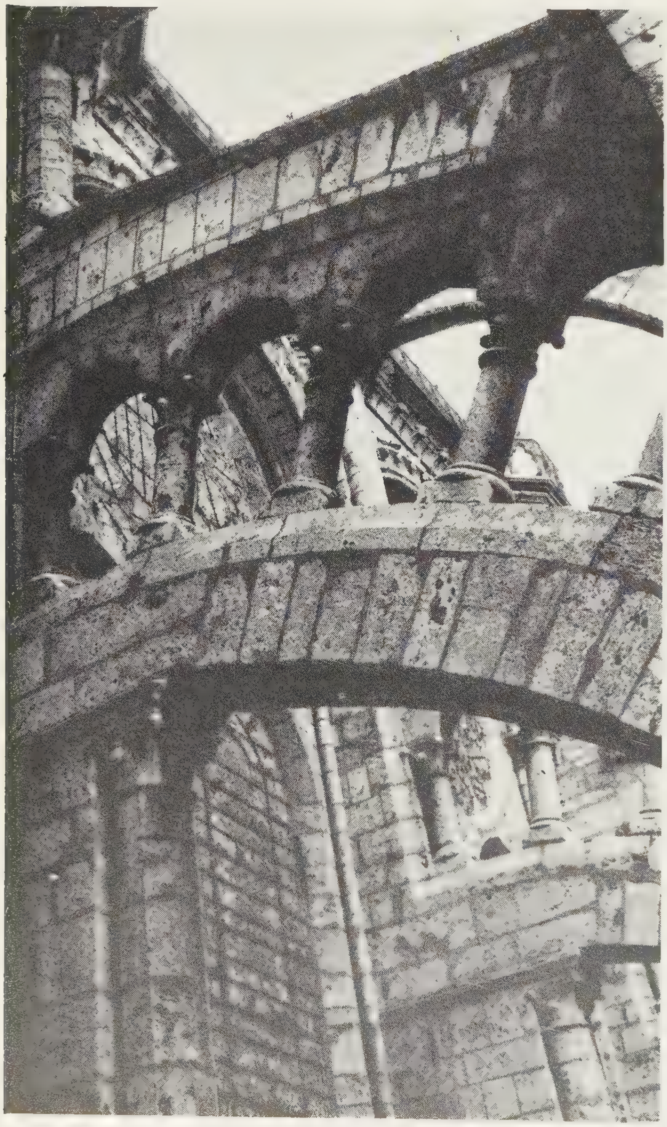
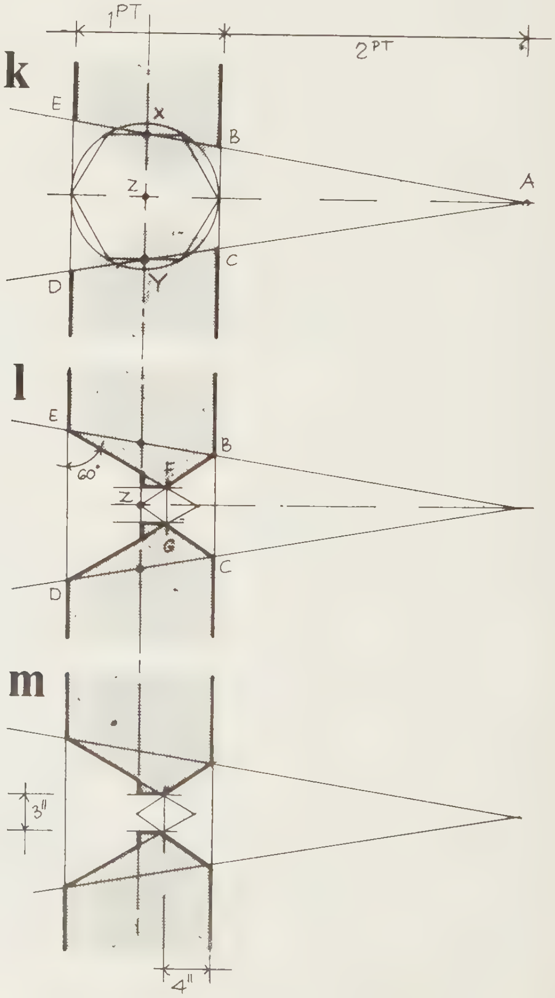


PHOTO 448: The flying buttresses of the nave, possibly the first to use spokes to separate the two arches.



movement towards lightness and thinness on the inside of the clerestory zone, and for a fissured exterior. It was a denial that mass had anything to do with structure, at least above the aisle vaults. The enlargement of the glass eliminated the masonry from the inside, while the projecting flyers screened it from the outside. Employing the aisle and triforium as a sort of plinth, the rest of the building was transformed into an elegant pavilion, without walls, but with pierced projecting vanes externally and astoundingly brilliant glass inside.

English cathedrals did not use them. Their choice was to accept the outside look of the wall and the mass it implied. But the French, choosing to emphasise lightness, discovered a wonderful solution in the flying buttress, for at the one moment it resolved the structural problems and also hid the wall. The structural importance they placed on the flyers can be seen in the care they took to align the flyers to the supporting shafts and buttresses, and by the way they put them up. Fitchen has shown that the roof had to be erected before the ribs of the vaults could be begun.[39] At Chartres all three rows of flyer arches on both sides were built before the roof, and had to hold themselves up in the most unstructural manner for many years before the builders reached the top.[40]

They had to think of the buttresses in two ways: as part of the future roof and vault structure, and separately as independent unrestrained arches. This often happens in building. The exigencies of the process sometimes compel you to design it in quite a different way than you would for an 'instant' building. If the vaults and flyers could have been built at the one time, and instantaneously loaded one against the other so they were in equilibrium, the massive walls would not have been needed.

Jaques Heyman's statement would then have been completely correct, that "the typical Gothic structure is, in fact, an assemblage of structural elements acting one on another to ensure complete equilibrium of the whole."[41] Though true this does need to be modified by the ifs and buts of the building process. As in the Scholastic division between Form and Matter,[42] the master saw the "separation of the structure into clear and distinct parts where each element had to do more than merely accept its load or transfer a thrust. It had to be so designed that it aggressively proclaimed its role, dramatically evoking in the mind of the viewer the normally hidden play of forces.... There is an element of theatre in all architecture."[43] The principles of all stable construction depend on natural laws, and even the most extreme expressions of medieval architecture are an extension rather than a defiance of such laws. But only when the entire building is finished will each load and thrust be finally balanced out.

When an arch collapses it drops in the middle, and pushes out at the same time around three hinges.[44] The critical point is X, as any sag from the weight of the arch itself at S will push out the side. As long as X is stabilised a three-pin arch will not form, and it will not collapse. At Chartres there is a large triangular stone in this corner

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35. The wall thickness is the Bronze foot. The window design is quite pretty, **k**. Divide the wall in half and on it form a 60° triangle crossing the centre at X, Z and Y. Around X and Y draw another triangle to a point A placed 2^{TF} from the wall. The outside corners of the window will be found where this triangle cuts the faces of the wall at BCDE.

In **l** draw the inside splays at 60° from D and E, and the outside splays by joining Z to B and C. Where the two triangles meet at F and G draw the outside of the slot with parallel sides, and the window is complete. The construction is, as usual, expressed through the corners, not through the planes.

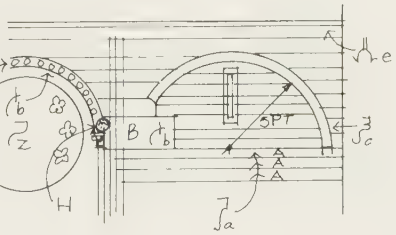
A subsidiary relationship in **m** shows that the slot ends up being 3″ wide and 4″ from the outside of the wall. The vertical exterior dimensions measured to the outside of the splays is $1:2\sqrt{5}$. It is nice to have one window begun and completed by the same master.

In **n** I have elevated the wall containing the window by the WN tower. The three rows of Ruby corbels are marked A, and to the left is the large single course B which is bonded into the clerestory wall, and was laid before the window and the arch - hence before Bronze. The arch has a diameter of 10^{TF} which, with the 1^{TF} wall thickness, confirms Bronze.

Was the arch meant to restrain the side thrusts from the newly raised roof, as the upper flyers (also by Bronze) were to do in the other bays?

At the bottom of the drip mould over the nearby rose there is a grimacing head H which is I think Bronze-*Oriental* - XI:24/c. Hence Ruby raised the platform under the room with his corbels while he was placing Cobalt's roses. Jade completed the roses and laid the arches over them doing no more in the room than lay B. Bronze then completed the major arch over the roses and the drip mould, and in the courses around it began the arched wall. Olive in the next campaign was more concerned with the vaults and did little over the rooms, except perhaps to vault them, and then Rose in 1224 completed the cornice, which is like the other courses in continuing unbroken around the corner into the nave. On the south side there is no B nor H.

n



36. In the choir the roof cornice is linked to the apsidal towers over a bridge which is part of the third arch of the flyers. The apsidal stairs and this bridge gave access to the roofs while the transepts were being built. See ch.XX.

37. Ackland, 1972, p.92, if not earlier at St. Germain-des-Près and Voulton.

38. Henderson, 1968, p.111.

39. Fitchen, 1961, and further in the next chapter.

40. You can see the reverse process in the many buildings where the flyers have remained in place after the vaulting has collapsed - Bond, 1913, i, p.407. See Longpont, and photos of Reims and Mont Notre Dame after the 1917 bombardment.

41. Heyman, 1967-8, p.30.

42. Panofsky, 1957.

43. Ackland, 1972, p.97.

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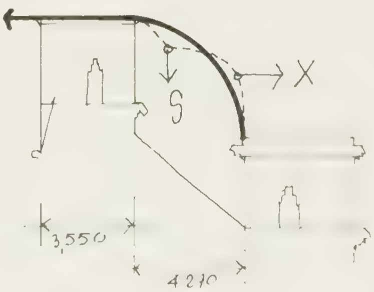

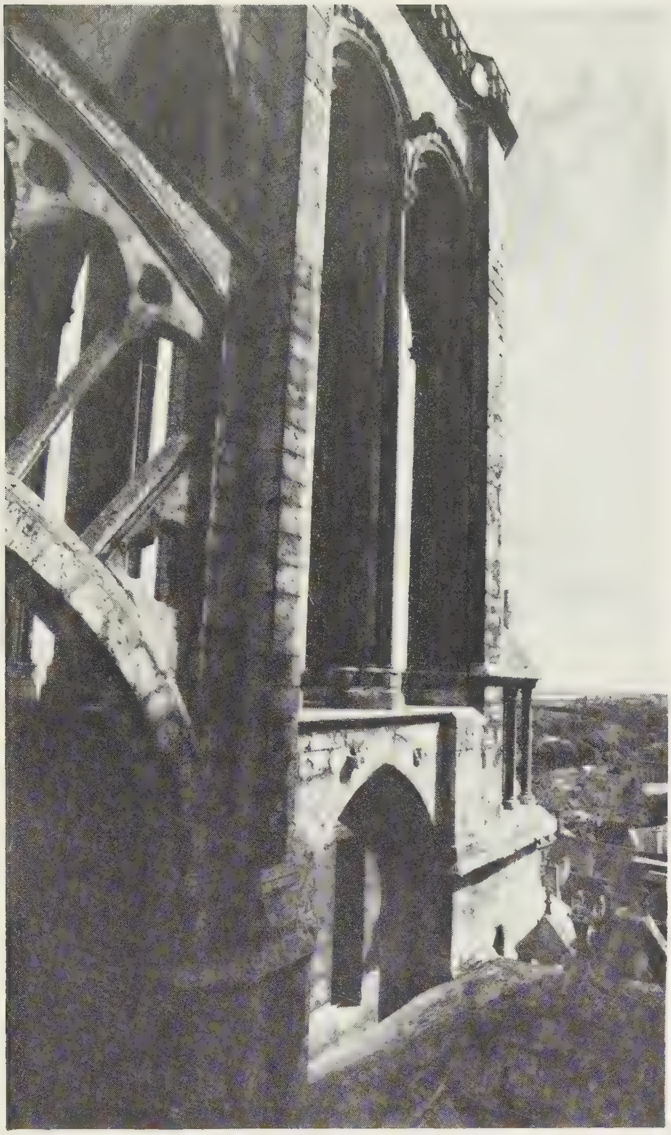

with a three-foil opening through it in the east.[45] Like a gusset plate in modern steel construction it anchors the arch to the buttress, and stabilises the potential hinge at X. In the upper arch the weight of S is taken through the radial spokes onto the lower arch, and the side thrust is continued outwards to be absorbed by the perimeter buttresses.[46] Against the inside wall the opposite thrust Y is absorbed by the thickness of the masonry and the heavy stones of the *tas-de-charge.*[47] The mass of the wall not only carries the weight of the vault and the roofs, but acts as a temporary buttress until the ribs are in place.

Thus both sections of the flyer assembly were designed to absorb their own thrusts until the whole work was complete. In later buildings the walls and buttresses were often built without the flyer arch in between. These were to be inserted when the vaults were built. Occasionally as

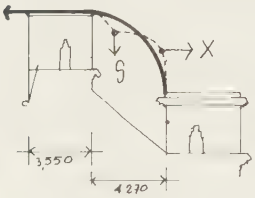

PHOTO 450: Cobalt's three-foil gusset plate stabilised the seating of the arch against the pier of the ES tower.

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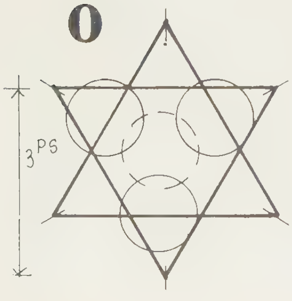
[45] The three-foil gusset plates in the choir were begun by Cobalt. The opening was designed from a Star of David, each triangle of which was made 3^{SF} high in **o**. The three circles lie on the sides of the hexagon formed by this star. In **p** the central opening comes from the square around the middle circle of the hexagon, shown dotted in **o**. In **q** see how the splay around these four circles come from the triangles of the star.

[46] "One can see that the whole system of arches penetrates the buttresses, as it were in a channel, that all the joints of the stonework are normal to the curves, and that finally, it is a completely oblique construction intended to resist weight that also pushes obliquely". Viollet-le-Duc, 1858, i, p.62.

The spokes would, in fact, be the weakest part of the construction, for in movement the weight of the upper arch would bear down on the spokes, which would press on the lower arch voussoires. This would push them down, popping them out of the arch under some circumstances. An arch acts like a shell by retaining the forces within the thickness of its voussoires, and pressure at right angles to that could push the arch to a point where the line of forces no longer lay within the voussoires. Collapse would follow.

[47] The wall and buttress at the *tas-de-charge* is 3,550mm thick - n.44. It dates from 1215 being the work of Scarlet. They are in every case built with the lower parts of the flyers, and with the adjoining masonry and the arches over the lancets. Fitchen, 1955, p.75 suggests that the *tas* originated 'where there was no room for each rib to be a separate piece of stone'', which makes sense to me. But also, after reading Alexander, Mark and Abel's splendid analysis of how the forces actually do operate within a vault, I think that the *tas* is also the most efficient constructional technique for absorbing all the loads which collect above the

o



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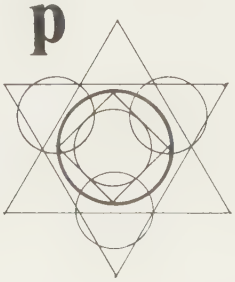

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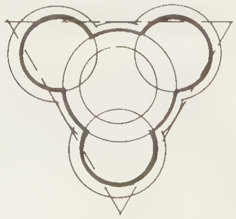


springing. Were the masters aware of how the forces of the vault aggregate at the springing rather than being supported progressively along the ribs? If they were, the invention of the *tas* fittingly solved both the structural and the constructional problems.

Barnes, 1963, p.71-2 dated the *tas* at Soisson around 1205, though he has now revised these figures. From new documents and further analysis of the building he suggests that, as at Chartres, the clergy's occupation of the choir in 1211 was under a temporary roof set up over the triforium, and not under the high vaults. This makes the Soisson choir almost exactly contemporary with Chartres, using the same three-storey elevation, similar designs for the triforium and the clerestory, and the same low-set junction between the flyers and the springing.

Branner, 1962(2), p.41 dates the *tas* at Notre Dame about 1205-10 which should be re-examined as this conflicts with the generally held view that the porches in the next bay were at that time just out of the ground. The heights of the *tas* are discussed in GEOM:XVIII-E.

This would not have been an easy stone to carve. Not only do the curves require delicate handling, but as the three ribs move outwards the partially hidden inside roll mould of the rib moves out too, until it emerges from behind the transverse arch roll at E. Above the springing there is a slight change in the radius of these members - XIX:18. Notice that Scarlet's templet for the transverse arch resembles Ruby-I's aisle vault arches, while his rib templet resembles the arches he had set over the triforium arcade in 1209. It would seem that the use of two sections in the *tas* was a unitary manouvre, tying this part in with the aisles and arcades in the transerve arches, and the triforium in the ribs.

BRONZE-X:

Choir and S.I lower courses. Completed by Scarlet and Cobalt, to consist of five courses to the lancet spring, and finishing a little higher than the nave. The centre of the ribs is set closer to the centre of the shaft than in the nave, but I have not been able to measure it. The actual pitch of the ribs above the *tas* is a little steeper, especially noticable in EN.I, where I think Cobalt was altering the pitch of the ribs. There is no stilting. In N.I. the arch and ribs are stilted 3 courses as the bay is narrower than the choir, and then all three begin to curve together. Notice this was not done in the south. Presumably Scarlet.

COBALT-Z:

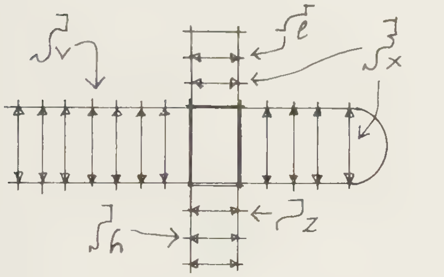
From the caps in n.53 S.I is by Cobalt. The ribs are stilted for six courses, and the ribs begin to curve out at the 5th. At the 7th the curve was altered to a higher pitch. The *tas* consists of four courses above the stilting.

RUBY-h:

From XIV:29. The rib is set in behind the transverse arch so it does not cross over in front of the stilted section - a sophisticated arrangement. The centre of the rib lies over the shaft. The arch is stilted 5 courses, but the ribs are not stilted at all. Total of stilt and *tas* is 9 courses.

GREEN-l:

From XX:32. The plan is like Bronze's, but the arch and rib are stilted together for 6 courses, then a *tas* of three. The coursing on the west side is smaller than on the east.



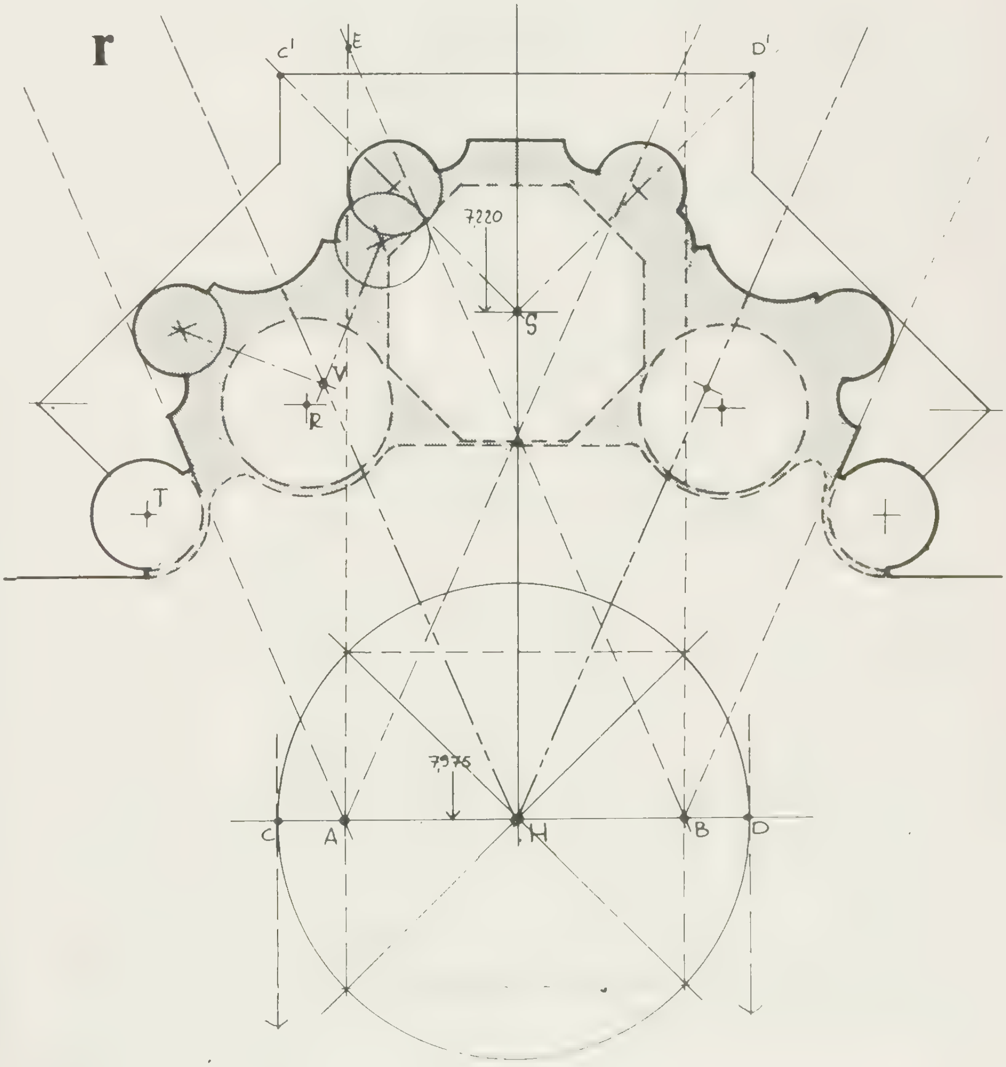
SCARLET-V:

The nave *tas* consists of 3-4 courses from impost to springing of lancets arhces. The plan arrangement is shown in **r**. The centre of the rib V does not lie over the centre of the shaft below R. The construction is very beautiful, and shows how Scarlet was concerned to evolve both rib and transverse arch from a common core, which derived from the flyer itself, and was centred on the H axis. For the continuation of this geometry into the buttresses see GEOM:XVIII-D & E.

The flyer arch was made one tenth of the bay wide, and was projected into the pier to the H axis, marked CD. It was also continued inwards to form the impost over the shaft S'C'D'. The √2 reduction of CD, AB, was then projected to form the width of the transverse arch. From H string lines were drawn to their corresponding centres on the other side of the nave, and the width of the diagonal ribs were also taken from AB, but being inclined were therefore smaller than the transverse arch.

HV was made equal to the tenth of the bay, like the flyer arch. Note that V does not sit over the centre of the rib shaft R, because Scarlet located his H axis at 7,942mm from the middle of the nave, compared to Cobalt's 8 meters, GEOM:XI-D.

r



48. A drawing by Wenceslaus Holler shows York Cathedral from the south. The walls were built with recesses in the pilasters between the clerestory windows to take the stones of the future flyers. This seems to have been a later technique, for all the flyers in Chartres are bonded into the walls. See Fitchen and Salzman. Drawing Collection of the Royal Commission on Historical Monuments.

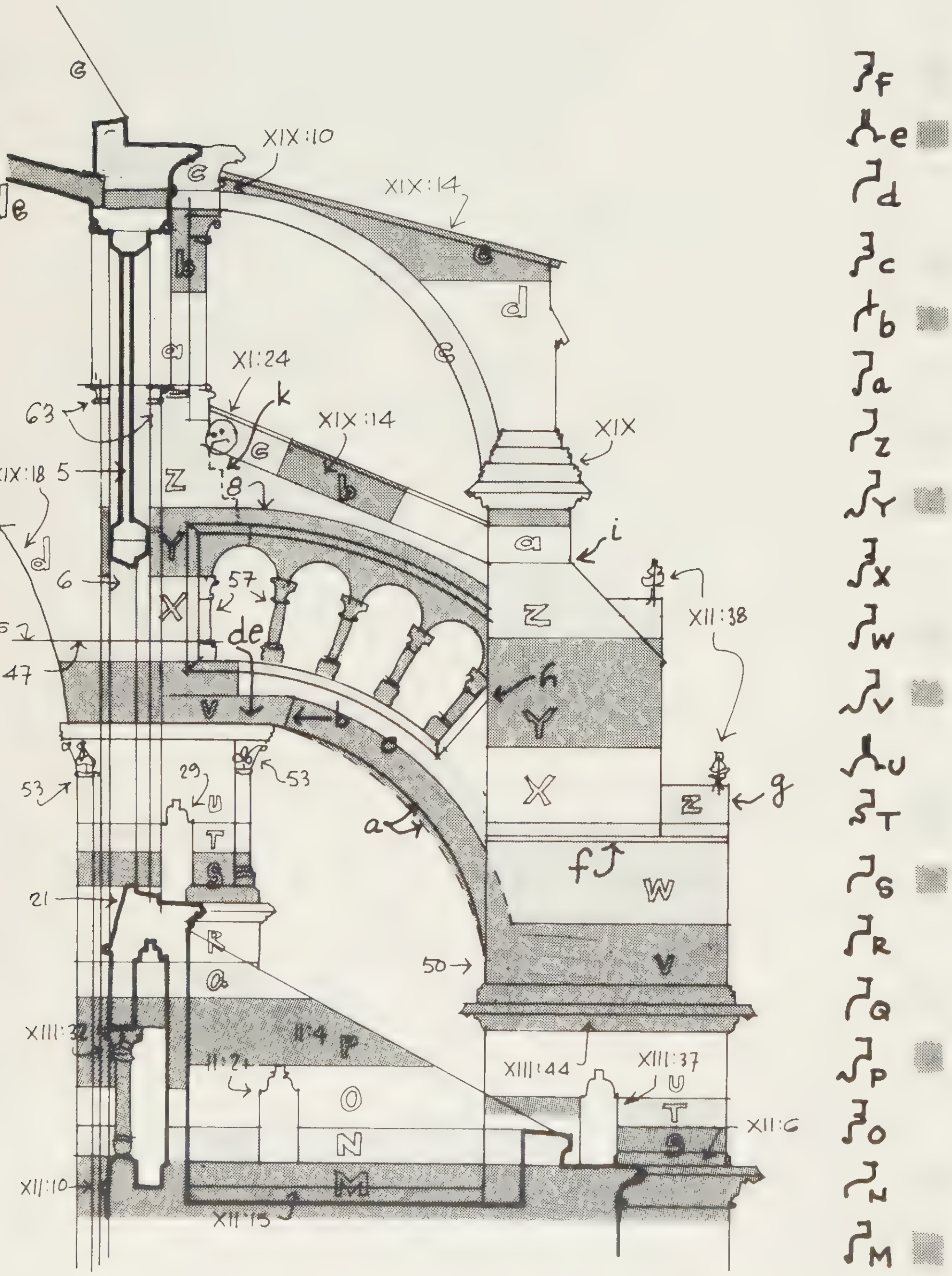
49. *Section through the nave clerestory*

a. I carefully measured the radius of each of the lower flyer arches, using three meter rods. The western four on the south side have an average radius of 5,130mm, whose centre is set closer to the nave than the shaft in the wall buttress. It therefore meets it with an upward angle. See 'b'. The formwork for these were by Scarlet, to the crypt geometry discussed in GEOM:XVIII-E.

The arch in bay II by Ruby-W has a radius of 4,730mm. This centre lies on the buttress epicentre - GEOM:XII-G - and Ruby built the arches in the choir from the same position. But as the gap between the epicentre and the buttress is less in the nave, and as Scarlet had already laid the projecting stone at the top of the arch 'b', Ruby had to use a smaller radius than in the choir. See GEOM:XVIII-F, and for choir n.58 and GEOM:XVIII-B.

The arch in bay I is Bronze-X, and has a radius of 4,053mm, and seems to have been calculated at half the aisle bay, or as 12^{TF} The distance between the centres of these arcs may have been 1½ times the SS centres, which is also 1: $\sqrt{3}$ the EE centres (7,220:10,830:18,770).

b. The top of the arch rests on a large stone which projects beyond the capitals. They are all alike and are cut for Scarlet's radius -as can be seen where Bronze's flatter arch meets it in bay I. Hence all are by Scarlet with his *tas* - n.47. Ruby's approach in the east is to rest a small part of the uppermost voussoire on the capital.



c. Scarlet's arches are finished square on the bottom edge **t**. Compare with Ruby's in the east which are splayed - n.58/a. Scarlet began all the parts of these arches including the rounded edges to the upper course. The arch is 2^{PM} wide by twice his $\sqrt{2}:\sqrt{3}$ ratio high, and the scoop along the top reduces the width by 1: $\sqrt{2}$ and the height by 4:5. Arches WS.III,IV and V are made of small stones, and the same in the north. I presume that these are the work of Ruby.

d. Scarlet's arches sit over the middle of the buttresses, irrespective of any bends along its length, showing that Scarlet imagined that the thrust of the arch met the mass of the buttress at the face, not at some point within it - GEOM:XII-E & XV-A. The exception is Bronze's WS.III & I where the second course of the arch was shifted over the lower by 50mm. Measurements show that in the new position the arch thrust is directed towards the epicentre, not the face of the buttress: Bronze-X.

e. In WS.III the lowest course of the arch bends where it meets the buttress, but the second course is almost straight and overhangs the lower. The base of the spokes over that hang out a bit further so that the upper arch is completely straight from buttress to wall. I am inclined to put construction joints between each overhang - see ISOS-V to X and n.57.

f. At the top of each ostium there is a gable roof. Its edge is continued along the sides of the buttress, with a joint through the middle of it. In some cases the second course continues the splay of the roof, A in **u**. In many it is ignored B, and in a few the buttress is widened over it C. I have distributed them between Ruby-W, Bronze-X and Cobalt-Z. The use of 3-foil round arches at the top of the ostiums in **v** is typically Ruby as in the sanctuary aisle window arch, the lintels over the transept stair doors - X:50 - and in the north porch - XVI:38.

g. In the gables over the ostiums the three western ones have small 4-foils incised into the two upper stones. There are none in the east. They would be Bronze, typical as in XIII:62 and XV:24.

h. Level with the top of the gussett in most buttresses the stonework steps in showing where the joint is. This brought the inside face of all the buttresses into line after the at York neither flyer nor vault were built and the stumps bear witness to the method.[48]

Each master seems to have had his own ideas on how the arches ought to be set out. Perhaps the diversity around 1200 was greater than it was ever to be again, for the flyers were an innovation, and naturally as more were built the worst methods would be discarded. But in these early years imagination must have raced ahead of experience. Three masters worked on the centering of the first arches in the nave, and each used a different radius. This is quite obvious in the photograph,[49] and accounts for the small nibs occasionally found between the first stone of the arch and its springer.[50]

The spokes which join one arch to the next are the earliest known in a Gothic building, and are the only ones to radiate. Vertical ones are easier to set up and will

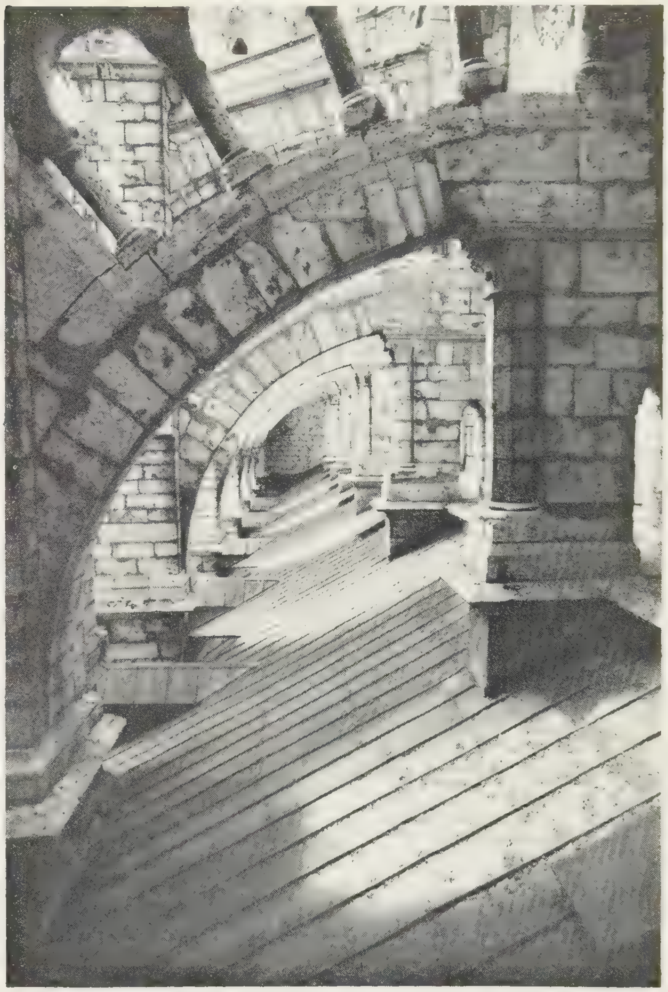
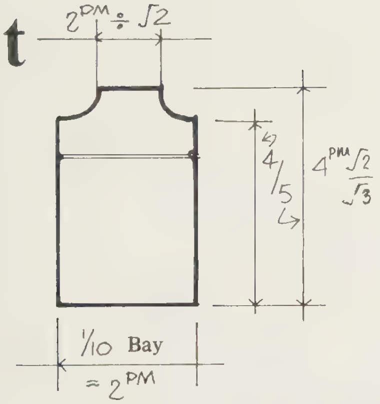
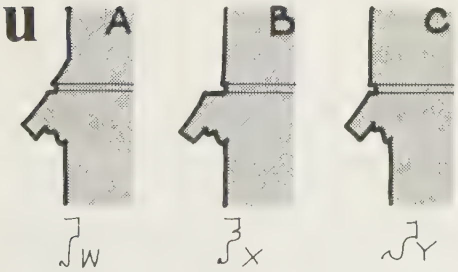


PHOTO 453: The flyers on the south side of the nave. The different radii discussed in n.49/c are clearly discernable.

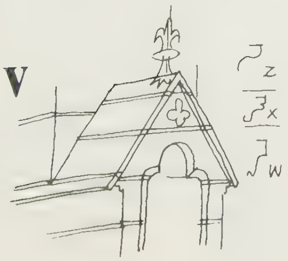
t

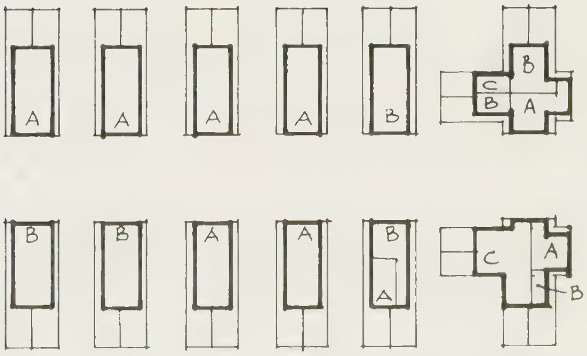


u



v





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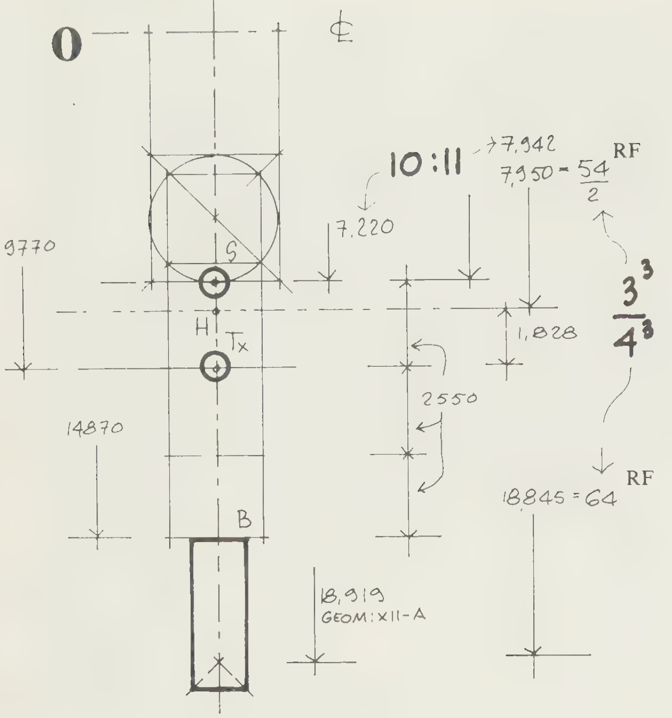
spoke arches were laid.

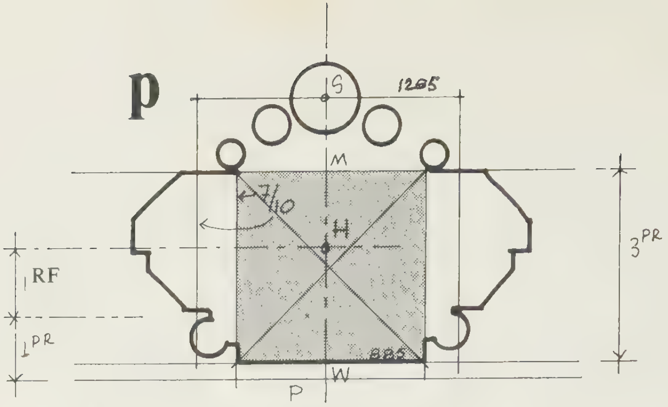
i. Similarly there are steps in the wall at the top of the uppermost splays indicating other joints.

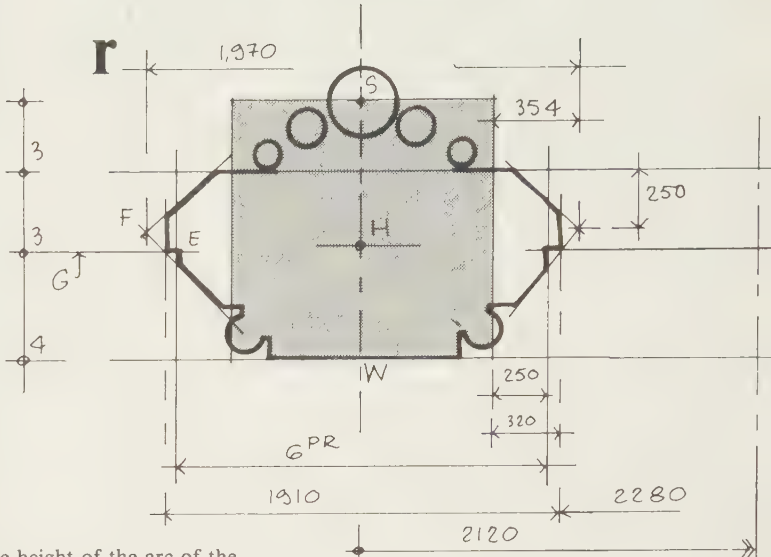
j. Other references are given directly on the drawings. From all this the north side of the clerestory seems to be slightly ahead of the south, and the east ahead of the west some of the time, and reversed on others. See also the tumours in n.8.

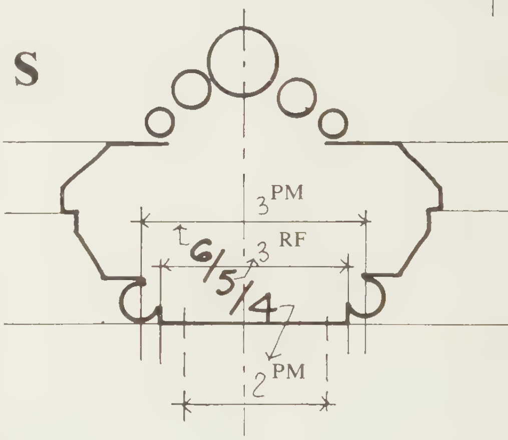
k. There are joints between the wall and the upper flyer in the three eastern buttresses. This is discussed in n.73/b.

[50] Delaporte, 1959, p.311 remarked on the one on the transept side of the WS.I buttress. He concluded from it that the transept had been added though it is just an indication that the radius of the arch had been raised by Cobalt from what Ruby had intended. His conclusion is larger than the detail justifies. Its position is drawn in n.64.









Geometry XVIII-D

The choir clerestory pier, Scarlet-Y, 1215

Scarlet's scheme for the clerestory, as he would have built it given complete freedom, can be assembled from his windows and wall in the choir, the *tas-de-charge* and his flyers in the nave. It is brilliant. The centre used for the arc of the flyer arch in n.49/a shows that he might have placed the outside shaft T at Tx if he could. It is a tighter scheme than Ruby's, and the piers adjoining the windows are not as large. It is as if by using a thicker flyer arch than Ruby he was free to reduce the wall and open the window.

Divide the space of the nave into two parts, and from S to the inside of the buttress into three parts, in **o**. Ruby had positioned this earlier from 20/11ths the span. It is delicious that one square is √2 times the other. Then insert the H axis, which may be 27^{RF} from the middle of the nave at 7,950mm. This could have been related to the epicentre of the outside buttress. It had been established at an average of 18,919mm from the centre in Cobalt's plinths. Scarlet could have worked to a centre slightly within the buttress, without altering its outside face, so that the distance to the middle measured 64^{RF} The ratio so formed is 3^3:4^3. If he had read the S-S distance at 49^{RF} (7,214 x 2) then his sequence would have grown to 7^2:8^2.

Alternatively the distance between the S shafts was enlarged by one tenth for the H axis at 7,942mm. In this case the effective epicentre may have been placed 16 of these units from S, and 26 from the middle at 18,775mm.

However, I prefer the scheme where the H axis was placed 1^{RF} less than the axial span of 28^{RF} from the middle of the nave discussed in ch.VIII. For then, when he drew the two 18,800mm squares to define the buttress epicentres EE and the height of the arc of the flyer arch, the H axes would have been located by 60° lines. These are shown in the next geometry.

Scarlet accepted Rose's interior wall face and increased it by 3^{RF}, forming the shaded square in **p**. WM relates to WS as 10:7, being an approximation for √2. W is virtually at the centre between S and Tx. The plinth P was placed 1^{RF} outside the arcade axes, presumably balancing the H axis which lay 1^{RF} inside it.

SW was extended into a square, shown in **r**, and the mullion was 'added' onto this. However, it is not a half-mullion, as Scarlet was constrained by Rose's cornice on the inside of which he had already carved the interior splays of the windows. The 3^{RF} wall thickness was doubled into a 6 x 3^{RF} rectangle to locate the rebate E, and the point between the splays F lies over the centre of the shafts in the *pilier cantonne*. The line of the glass G does not lie on the H axis, but SW was divided into tenths to relate S to the internal wall, the glass and the outside, shown on the left.

As a result (?) the glass line may relate to Tx, measured from the middle of the nave, in Scarlet's oft-used ratio of √2:√3 (7,975 :9,767), with the base for this construction being almost 4/5ths the bay (5,640:7,050). Notice how the jamb dimensions, shown on the right, revive other key dimensions: 354 is the PM and half the width of the flyer arch, 250 is 1/√2 that and is half the width of the transverse arch, while 320 is virtually one quarter of SW.

The width left for the glazing between the edges of the jambs and the central mullion is 2,280mm, and this may have been related to the space of the nave between the walls as 3/10, or the centres of the glass panels may have been taken as 3/10 of the bay (7,080 x 3/10 = 2,120). The glass seems secondary in the evolution of these ideas, as if the building was not designed primarily to show it off, but for the necessities of stonework within which the glass was to be held and subordinated. Geometry seems to confirm what the cost analysis in VI:47 tells us, that in spite of our excitement with the glazing, the stonework of the building was more important than the glazing, at least in the eyes of the builders.

The attached shafts flanking W in **s** relate to the 3^{RF} width of the pier face and to the 2^{PM} flyer arch as 6:5:4, or as 3^{PM}:3^{RF}:2^{PM}. A very happy solution.

...XII-D & G/*/XVIII-D...

perform the same structural function, as at Amiens, Auxerre and the original choir at Troyes.[51] The fact that both nave and choir spokes follow this unique radiating arrangement shows they were built at the same time, and before the others in France. They seem to have had two purposes. Firstly a decorative one because they do not in fact play an essential role in stabilising the building.[52] Secondly a constructional one for they eliminated the need for centering under the second arch. Yet neither reason seems completely adequate.

In both Chartres and Soisson the lower arch butts into the bottom of the *tas-de-charge* just above the capitals[53]. This is the old fashioned technique of the Durham nave before it was realised that the thrust from a pointed arch emerges some distance above the springing, and in later double-arched flyers the lower arch is raised. They must

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[51] A drawing was made of Troyes cathedral while the houses of the town were still built up against the walls in 1854, and before much of the upper choir had been rebuilt in the next decade. A photostat of this was framed and glazed, and was hung against the iron railing around the choir. Norbert Borngartz who was studying the building assured me it showed the original buttresses. The drawing shows that the original flyers had spokes, and that they continued all round the choir - though found today only in the two transept flyers. Nineteenth century egotism has made our work more difficult than all the wars and weather of seven centuries.

[52] From an engineering point of view they tend to work against the natural stability of the arch by pushing on the lower one where it is weakest.

[53] There is an exception discussed with references in Heyman, 1967-8, p.22-5. See ch. XIX. The heights in the nave were established by Rose, and were continued by other masters - n.12 and GEOM:XVIII-E. The crossing was a little retarded as the piers were much bulkier. See similar circumstances in XI:19.

Capitals to the vault spring.

Rose's leaves are small, and are placed like buttons on the capital. Scarlet's are large, often covering the whole of it. Rose makes his concave, and some have a deep gash instead of a rib. His leaf is a stylised shape with a simple outline, while Scarlet's are more naturalistic and and complex in outline. Some of Scarlet's are large flat maple leaves with well-formed thin veins covering the surface with a pattern of wavy lines. The points are sharp and the indents around them drilled, but almost never lapped - *Peterloo* and *Squid*.

His crockets are delicate, and though the ends are sometimes large, most are tiny - *Hoe*. In both of them the leaf and the berry is articulated with care so that each part is clearly visible. This is a rare device, for many masters just form a lump at the end, roughly shaped into a leaf or two - especially at this height in the building. In spite of the weathering, which has not been great in most cases, the differences between the work of his men and the others is pretty clear. See his also in the nave triforium - XII:32/III.

a. There was a wooden tie placed across the nave. It may have been placed by Ruby-W after the capitals inside. He believed that the thrust from the transverse arch would be taken at the springing. His successor in the other capitals of the crossing, Bronze, knew this was not so and left them out. Follow this corner in n.67.

b. Canon Delaporte, 1959, p.305 noticed that inside the building the capitals of the crossing are differently arranged on each side. On the west the central shaft continues past the adjoining ones as if it was to become a shaft up the corners of the next stage of a crossing tower - as at Braine or Laon. The shaft is capped off with a tall impost, which is not the same shape as the others, and is large enough to support the enormous crossing rib built by Rose in 1224 - XIX:18. Delaporte thought that the higher rib shows that the master had intended to cap the crossing with a squinch-and-dome arrangement as at nearby Bonneval, and that the lack of it on the east shows they had decided to dispense with the crossing tower altogether. I think this is concluding too much - it is sufficient to say at this stage that Scarlet's plan for the junction of the pier and the tower was different to Ruby's and Bronze's.

c. For the implications at the western end see XIX:33.

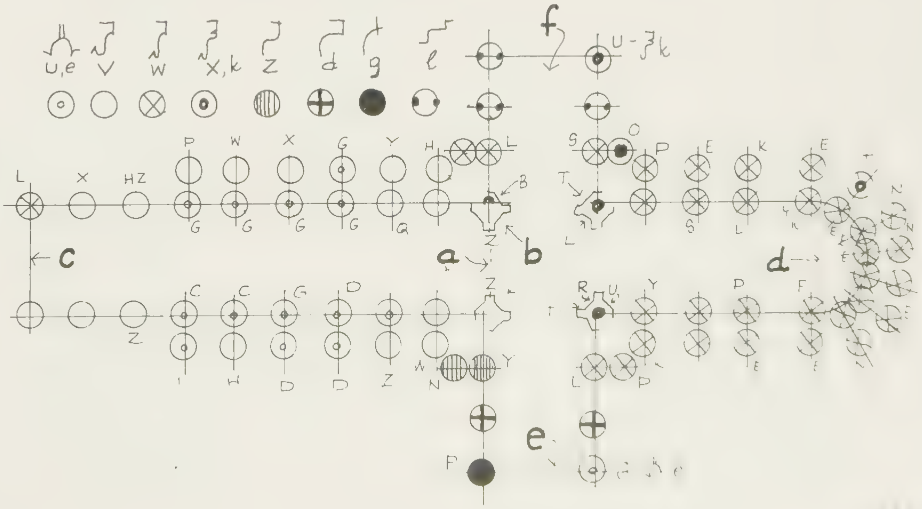
d. Apse capitals are *bec,* like Ruby's in the chapels - XI:49. Five men seem to have carved all Ruby's capitals in the east - one gang?

e. The southern caps - XIV:29/m & n. The caps over S.II are later than those beyond them on the terminal wall, as can be seen by comparing XVIII:29 with XX:32. The S.II piers were therefore delayed while the southern wall was pushed ahead. Presumably also to suit the position of the scaffolding and access ways from the cranes alongside the nave and choir. Note that Jade's caps are cut for circular shafts, even though the stone *en delit* shaft under it is octagonal. What went wrong with the client's supervision? See later text.

f. The same thing happened in the north with another crew - Green. On the NW the shaft under the cap is also circular down to the string over the triforum passage. All the rib capitals are set at 45° except for Green's which are angled to suit the direction of the ribs. An advanced technique for a local builder in 1231?

The letters used for the gangs apply to this note and to n.57.

ROSE		
	C	Cotton
	D	Dollop
	G	Goose
	I	Piker
SCARLET		
	A	Spade
	H	Hoe
	P	Peterloo
	Q	Squid
	T	Tool
	W	Screw
	X	Flix
	Y	Shelly
	Z	Zulu
COBALT		
	N	Noblick
	Y	Yawl
BRONZE		
	L	Lobelia
	N	Nipple
	O	Odrill
	R	Spring
	T	Tips
	U	Bustle
RUBY		
	A	Flap
	E	Eyes
	F	Frills
	K	Locks
	L	Lobby
	N	Plane
	P	Pawn
	S	Circus
	Y	Curley
OLIVE		
	P	Spout



54. See next chapter.

55. Heyman, 1967-8, p.25; Fitchen, 1961, p.69; Viollet-le-Duc, 1858, i, p.72-.

56. The third row was added *below* the first two after the collapse, see L. Benouville "Étude sur la Cathèdrale de Beauvais", *Encyclopedie d'architecture,* Paris, 1891-2.

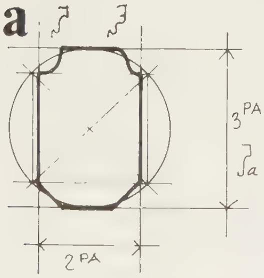
57. *Nave flyer spokes, drawn on the right.* All the bases to the spokes adjoining the windows are built with the wall by Scarlet, Ruby and Bronze as you can see in the drawing n.49. The bases under the other columns are carved in the one stone with the caps. The upper ring of the tori in four columns in SW.I are not like any other on the job.

I have identified Scarlet's leaves from the ones he did in the triforium passage, the three he did in the WN(cw) walkway, those in n.53, and those in some of his sculpture. They form a group that can only be given in consistency to one crew. A few others may have been carved by Bronze, and it is most probable that he carved 'a', in which case he determed the height of the flyer spokes, so that the underside of the capital coincided with the springing of the lancets, n.6.

The few by Bronze were set out with the lancet arches, with cleanly cut leaves which work around thin crockets ending in a bunch of leaves which mould round one another, and with two drill holes. Ruby's crockets are thin and fat, with less differentiated ends, and are more ball-like. Some crockets have no ends, and some are curled - *Pawn, Curley, Frills* and *Lobby.*

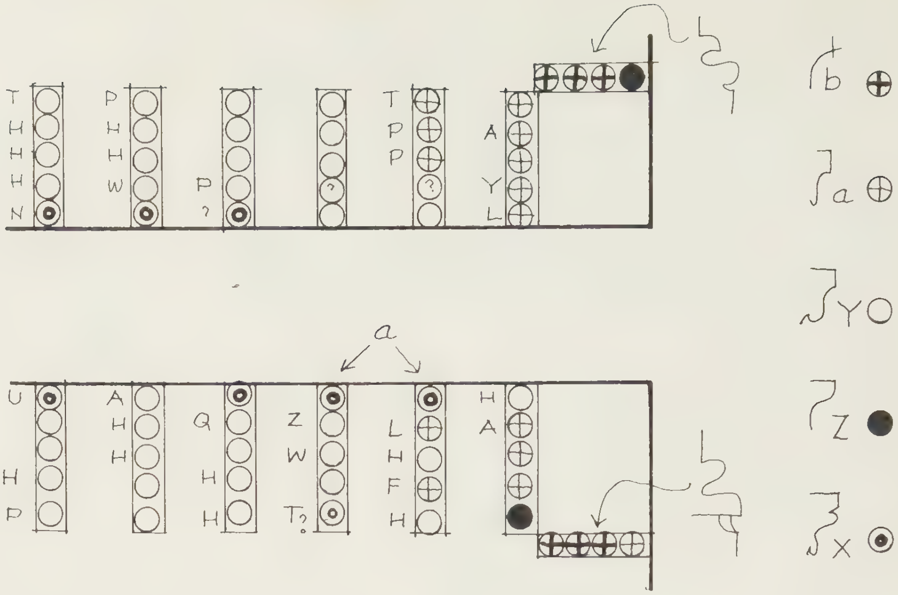
58. Simson, 1964, p.233. See X:43, and XIV:8.
   a. The choir flyer arch is narrower than in the nave, being 2^{EF} instead of 2^{PM}, and it has only 60% of the nave's cross-sectional area - n.49/c. In **a** make the rectangle of the arch 2′ x 3′ and within the height draw a circle.

a



The square within the circle determines the splays. Except for the lowest stones in some arches (by Ruby, shown on left) the curves on top are doubled as in the upper piers of the EN tower (shown on right), by Bronze-X - XIV:17. In the arch Ruby used the same set-out point as in the nave, but as the span is larger this radius of 5,070 is greater, and is half the distance from the middle of the building to the centre of the arch -GEOM:XVIII-B. The shape and details of the choir flyers are uniform all round, so were all begun by Ruby-W in 1216.

   b. The gussets were begun by Cobalt-Z - n.45. The splay is larger in some of them, by 35mm, so it often meets the edge of the stone. The larger ones would be later, the work of the next master Ruby-a in **b**. The single stone in NE.I is presumably Jade-b.
   c. The spokes are also Cobalt, derived like the gusset from the flyer arch (or the SF) in **c** by triangle and diamond within a square.
   d. Above the spokes the pointed arches are all jointed the same way to one another, but where they meet the gusset some finish square, and others have a small curve to finish off the splay of the spoke **d**. Ruby's are drawn in black on the plan and Jade's are outlined. Between the arches Ruby placed the same circle as he had used over the sanctuary windows and later over the north rose lancets - X:43/d and XX:28/o. He disliked blank spaces, and liked mixing round arches with pointed, though on the whole he avoided the pointed arch. Had the arches been begun by Cobalt?
   e. The inner arches next to the windows meet the spokes in the same way **e**, and can be similarly divided between Ruby and Jade in the plan.



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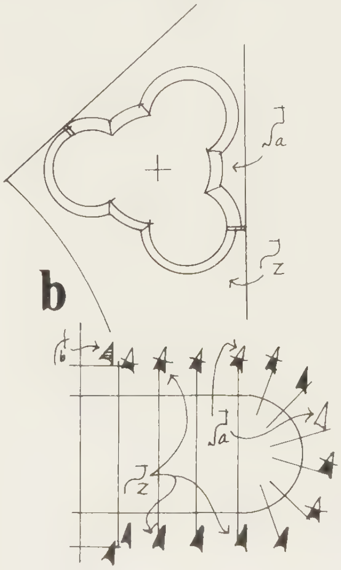
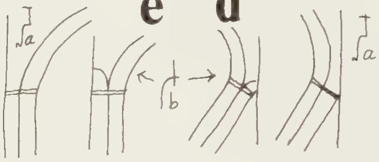
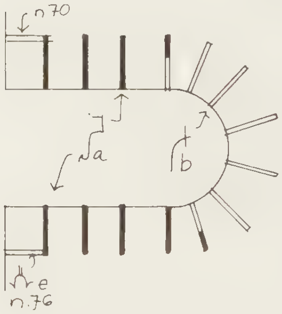


e **d**





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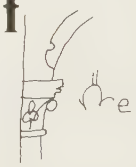

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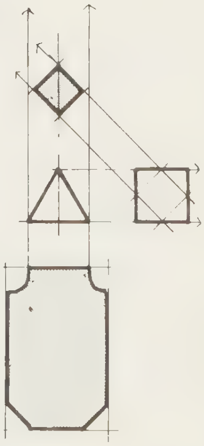

have had some understanding of what was happening for they continued the thick-wall buttress between the two flyer arches.

The purpose of the upper arch may have been twofold: to pick up any higher component of the thrusts not collected by the lower one, and to stabilise the upper part of the wall against wind loads. As the topmost flyer arch was not intended from the beginning the others were designed to withstand all vault and wind loads.[54] The flyers were made more efficient in later buildings by raising the lower arch some five courses above the springing, and more in very tall buildings like Reims and Beauvais. The upper arch was raised proportionately so it no longer took any thrusts from the vaults, but only those from the wind.[55] Thus the need for a third row was removed, so that even in giants like Beauvais they used only two arches without any spokes between them.[56]

The spokes in the nave are incredibly heavy: they consist of thick columns resting on large bases. Their capitals are big in comparison to the height of the shaft, and they support simple round arches.[57]

The main difference with the choir lies less in the thinness of the flyer arches - for this is only a matter of 100mm - than in Cobalt's decision to lighten the spokes, puncture their gussets with three-foils, and cap them with elegant pointed arches which verticalise the appearance of the flyers. The holes between the arches may have been Ruby's idea for Cobalt may have intended to repeat the three-foil arrangement begun in the gussets. The zones between one man's decisions and another's in situations like this is hard to place. Both masters were associated together in a similar situation seventeen years earlier in the upper parts of the sanctuary aisle windows. Again we find pointed arches capped with circular openings, but who made which decision where? In the aisles did the height of Ruby's lancets give Cobalt no option, or were circles the only acceptable solution in 1203, or what? There are no clues in the order of the teams in either place, but in a most perceptive piece Simson saw the stylistic similarities, and wrote that the masters who produced the "austere" design for the aisles "also designed the flyers of the choir."[58]

The thinness of the spokes and the holes punched around them make these flyers look even more like a screen. The details are lighter than the nave and less articulated, which maintains a sense of movement across it and makes it look higher than it is.[59] Cobalt omitted all decorative elements, capitals and bases, and by setting the spokes edgewise created a network of stone rather than a structure. The choir's spokes have no structural purpose whatsoever. It is purely a screen - which in a way answers my earlier question about the purpose of the spokes.

By building the nave flyers as structure Scarlet bound the two arches together. In contrast to Cobalt's decorative scheme the nave has a monolithic quality. I have the impression that Scarlet did not know where the thrusts were coming out of the vault, and played safe. If he had instead built the flyers as a solid wall he would have frustrated the openness of this area. Building the flyers as an arcade solved both problems.

The scaffolding needed to support the flyers would have posed many problems at this height. In the second chapter I described the method used in the triforium where it was convenient to build the cross walls first with its scaffolding carried across the bay, and then later to build the passage wall from the more extensive scaffold which had to be raised on the inside. This process was reversed in the clerestory, for the strongest scaffolding would have been placed in the direction of the flyers. Subsidiary scaffolds would have been needed only for the lancet windows and the infils under the roses. The lancet arches are at the same level as the arches over the spokes, and some ingenuity would have been needed to erect the one before starting on the other. The formwork needed to hold the spokes and place the stones of the arches over them would have been particularly cumbersome as the spokes are set radially. Each one would have had to be supported individually to stop them tipping over.

But in the walls once the lancets had been formed up no more centering would have been needed: the roses rest within the frame which is supported on the lancet arches, and from there on every course could be set directly over the earlier work. All they needed was a light platform to support the workmen.

In later buildings where bar tracery came to replace the heavy plate tracery used here, they would have been able to dispense with the lancet centering as well. Everything could have been held in place from the scaffold within the encircling and stabilising plane of the wall. Unlike the tracery of later buildings the lancets and roses in Chartres could not be inserted later - they are part of the structure. Branner has described how in the Reims and Soisson district they experimented with a number of ideas for dividing a window, and that the most common was to use a pointed arch, and to fill the gap between the lancets and the arch with an oculus.[60]

Chartres is unique, for here the circular oculus has been enlarged to fill the entire width of the bay. Framed within a round arch it forms a dominant element in the design. Set high up in the building it leads the eye inwards from the frame of the flyers to a resting point within each

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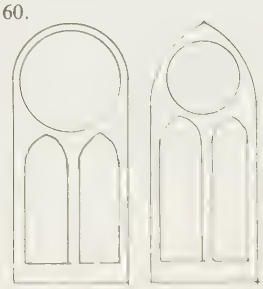
f. For changes in the transept spokes see n.70-73. As the SE.I has Rose caps, and his typical moulding at the bottom of the arch f they must have been put up in 1224.

g. The flyer is built with the wall, as can be seen in the jointing and where the edge of the coping over the second arch is extended into the window reveal.

59. Grodecki, 1958, measured them, and so did we - n.20. Grodecki is incorrect: measured to the edge of the drip mould over the arch where it meets the wall the heights of both the nave and the choir are the same - 8,800 ± 20mm to walkway.

60. Branner, 1965, p.15.

60.



Geometry XVIII-E

The springing of the vaults, Rose-U, 1214.

This is one of the most important visual locations in the building, for it forms the top of the nave walls before the vaults begin to close in. Apart from the openings into the aisles located by the arcade caps, and the purely decorative but important string courses, these capitals do more to articulate the internal elevation than anything else. It was a pity that they were placed by Rose who had made so few major decisions elsewhere, for it follows a proportional logic of its own, with few sympathies with other elements.

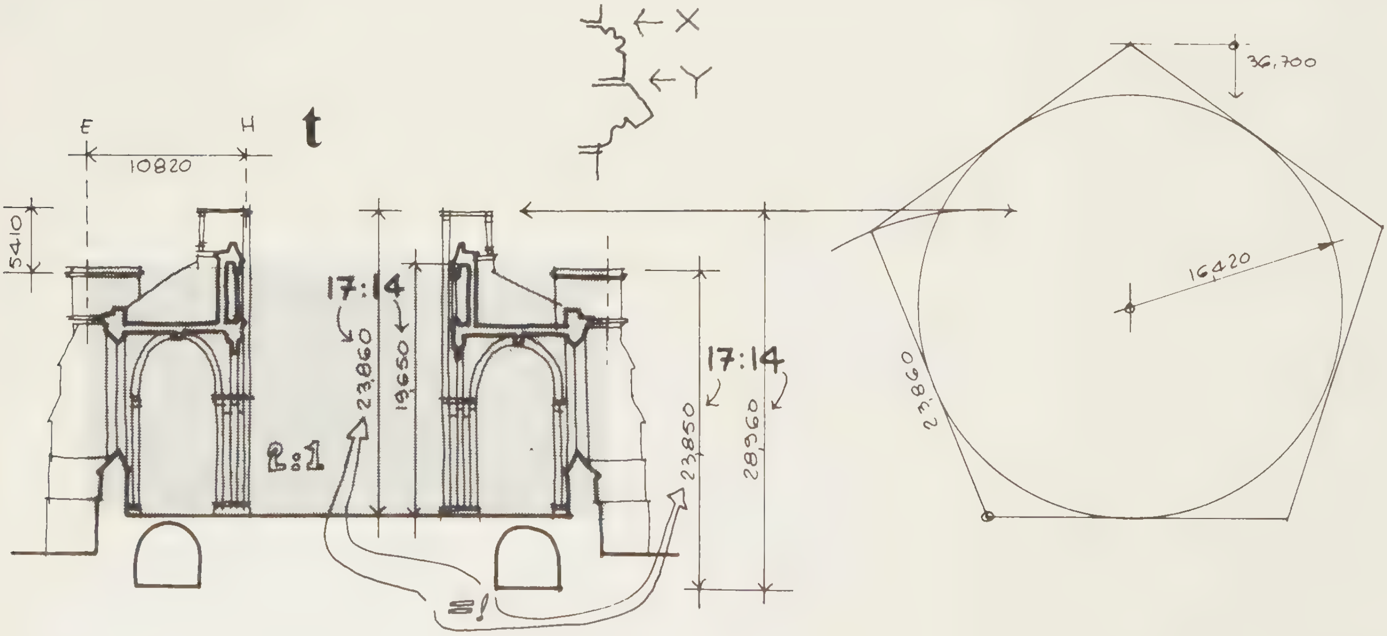
It continues his usual pentagonal construction, drawn in **t**, and from this and GEOM:XIX-C I presume he would have placed his boss at the apex which would have made the interior 2 meters higher than it is today.

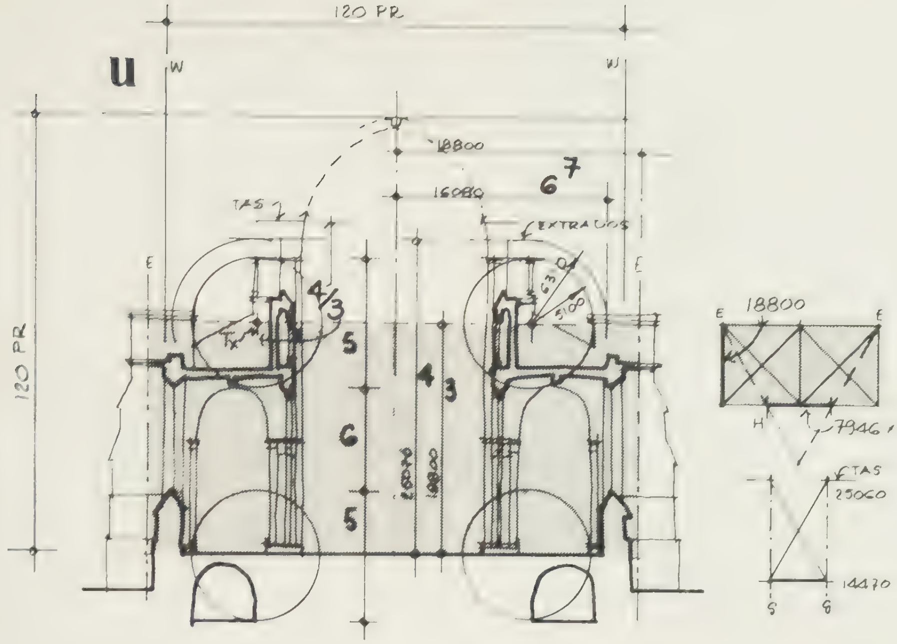
However, there is a possibility that Rose calculated his H axis as 7,950mm, and then his springing would have been 3 times that above the floor.

Rose related this springing back to other elements where he could. He lowered the height of the upper string course in the choir to give him a √2: √3 relationship, though calculated through the simpler method of 14:17. Outside he laid one cornice over the nave triforium walkway, using a thinner stone than the rest by Scarlet. If we assume that the next moulding, above which the plain walling of the buttress starts, at X in the detail, would have been the same height, then the same ratio would have been used outside. This is shown to the right of the drawing. The interior ratios are taken to the inside floor level, while the exterior ones are taken to the crypt. Also the height from X to the floor was equal to half EE.

But why would he want to make this moulding out of two courses? The top of course Y is 5,410 below the springing, and this is exactly half the distance HE. Perhaps one reason for the use of more complex mouldings was to provide more positions for reconciling different geometries that would otherwise not have been expressed. Here we have one ratio of 14:17 that is used inside and out, and a structural one of 2:1, and a pentagonal one to the vaults and axes. The springing cap and impost measures 2^{CF} high.

It would have been fascinating to have watched him carry this approach right through the building. You can see that Rose created his heights independently of any others inside the





building. He began with the circle of the span, and all his heights came from this axial dimension.

The nave imposts are the work of Scarlet. Their height from the floor is an average of 23,860mm, while 81^{RF} is 23,850mm. In the previous geometry I suggested he may have used 8^2 to the buttress epicentres, and 7^2 between the S shafts. The sequence would then have become $7^2{:}8^2{:}9^2$. He has used this set once before in the building, in GEOM:XIII-A. These measurements are not exact, as most were inherited, 49^{RF} + 6mm between SS, 64^{RF} + 74mm between ES, and to the top of the imposts 81^{RF} + 10mm (or +30 ex GEOM:XVIII-A). Also, as shown in XIII:45/**w** the height to the springing and to the top of the upper course of the mouldings of the nave walkway, taken from the crypt floor, may have related through his well-used 6:5 (28,960:24,050mm). The top of the cornice may have measured 80^{RF} to the crypt (18,460 + 5,100 = 23,560mm). I have summarised his more important ratios in **u**.

In the choir the impost is Ruby's, and is lower than in the nave. This may have been an interpretation of his other dimensions, being the closest his style of geometry could get to Rose's springing in the nave, as 3:9:12:14 - crypt height (5,090mm): triforium cornice (15,300mm): clerestory cornice (20,380mm): choir springing (23,780mm). Alternatively it relates as 5: $\sqrt{3}$ the axial span of 8,225mm, as on the right of GEOM:XVIII-B/**h**.

The springing cap is, in one sense, only the decorative and apparent start for the vaults. The real and structural support occurs above the *tas*. This ambivalence would have affected the way the master thought about the building, for he was compelled by structural needs to raise the actual springing above the traditional location at the capital. He had been trained to turn the vaults from the cap, but now he was asked to reduce the importance of the cap, though still retaining it as a decorative mark, and to locate the real springing higher up. When taken to its logical conclusion the capital was superfluous, which may be why it was often eliminted in later centuries.

There are three zones in the springing: the capital, which is also the underside of the flyer arch; the extrados or upper face of the arch; and the top of the *tas* itself which is also the springing for the lancets **u**. Within a decade or so the arch was to be moved upwards until it coincided with the top of the *tas*.

In the nave the capital was Rose's decision, but both the other two were Scarlet's. In the choir the capital was Ruby-W's, the extrados was Bronze-X and the top of the *tas* Cobalt-Z. In the choir Bronze's extrados of 24,660 could have been derived from

- The space inside the nave that the vault has to span x φ (15,220 x φ = 24,630)
- 1½ times the span (16,420 x 1.5 = 24,630)
- It is half the height to the ridge of the roof Bronze built later (24,650 x 2 = 49,300), and so relates to span and bay through GEOM:XIX-D.
- Plus one third it locates the top of the clerestory wall in the choir (24,660 x 4/3 = 32,850).
- From the crypt it equals the space between the inner faces of the perimeter buttresses (24,660 + 5,110 = 29,770mm).
- It would have been nice if it had related to the vaults as 1: $\sqrt{2}$, or its approximations of 10:14 and 7:10, but though close, the discrepancies are too large.

Scarlet's arrangement is more problematical, for an understanding of it depends on where he would have built his vaults and the top of his clerestory walls. He indicated this in the size of the western rose, which is so large that the two western bays of vaulting have been raised above the rest to accommodate it - XIX:33. The height to the top of the rose is 120^{RF} or 100^{PM} at 35,340mm. This equals the width of the nave to the outside of the walls alongside the windows in GEOM:VI-B, and half the distance from the labyrinth to the rondpont in his first geometry in ch.VIII. Thus Scarlet's overall scheme for the three-dimensional form of the cathedral (besides Bronze, he is the only master for whom we have enough information to determine what his grand view may have been) was for a double-cube, locating in the solid the tallest wall heights, the widest walls, and the diamond in the Creation Figure.

In the nave he placed his *tas* as 4/3 the distance between the Tx centres of the arc of the flyer arch, a horizontal distance which measured two thirds of 100^{RF}. (29,750 -5,100 = 19,650, x = 4/3 = 26,200mm). Further, the height of the extrados above the floor uses the same ratio, but to the height of the Tx centre from the floor (25,070 = 4/3 x 18,800mm). Notice how the simple and easily applied ratio of 4:3 relates both the extrados and the *tas* to the centre of the arch, one relating to the width between the centres, and the other to the height from the floor.

There are other possibilities: the width of 18,800 could have come from his intended S-S dimension as $\sqrt{3}$:1 (16,450 - 1,990 = 14,460, x $\sqrt{3}$ = 25,040mm) and, subject to GEOM: XVIII-A, the top of the *tas* may have come the same way from the space across the nave (15,200 x $\sqrt{3}$ = 26,320mm). The extrados height also measures 85^{RF}.

However, there is another important matter to consider. The top of Scarlet's clerestory walls would have had to match the top of the west rose, unless of course he was going to build deeply domical vaults, which would not have been fashionable in the Paris Basin. But Bronze-X began the arch over the lancets, and I presume he did so at a much lower level than Scarlet would have. This determined where Scarlet-Y in the next campaign was to put the underside of the rose. Yet if he was still then working towards a 100^{PM} wall height, he would have had to make the arch over the rose two meters higher than it is today, and there is only one way in which that could have been done - by building a pointed arch over the rose.

What then of Ruby's competition entry? These arches were made circular by Ruby himself two years later, so preserving in its entirety the scheme he had planned for in 1211. But the question posed by the height of the western rose, presaging Scarlet's beautiful double cube geometry, remains unanswered - could the Ruby scheme have been so radically altered in midstream?

In conclusion, notice that the vault heights are a by-product of other geometries, and are not primary. The most important part of the enclosure is the walls. The curve of the vault is secondary. See in GEOM:XIX-B.

Examining the elevation is like studying a piece of cloth, where different geometries weave over one another, independently skipping across the facade, and meeting only occasionally. Each makes its own contribution to the overall effect. Where the conjunctions are on the whole fortunate we get a great building, like Chartres.

...XI-A/*/XIX-B, C...

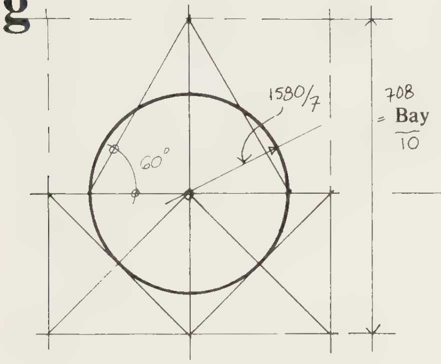
of these 'eyes of the church.' Pointed arches lead your attention upwards, and take your eye vertically between the buttresses without letting it rest until it has evaporated into the space over the roof. In Chartres the flow is interrupted and held within the form of the building. Your attention does not escape, but pulses horizontally from bay to bay, from one rose to another, until it is lead to its apotheosis in the gigantic stars of the transepts.

These roses were intended from the moment the lancets were arched over by Bronze in 1217, though their height could have been set earlier if Ruby had built any of the formwork for them. When looking for sources, remember that Ruby was responsible for the round arches over the windows to the sanctuary aisles, and that Bronze in his other work preferred pointed to rounded forms. Also, if the Chapter had had a competition for the windows in 1211 all masters would have had to follow that scheme. Ruby began the walkway in that year, which is another indication that he was its originator.[61] The commoner Soissonaise scheme could only have been built here if the lancets had been set higher up.[62]

There is no way of knowing whether roses had been suggested in the first model, or whether it was a decision taken twenty years later, nor whether the first scheme was simpler, or more advanced. I can only say that after 1216 roses were inevitable, and that they were carved and installed over the next few years by Cobalt and Jade.[63] The flow of work was from the west to the east, so the corner by the transept was last in the nave, but first in the choir.

This is the corner where the majority of churches become pretty neurotic. As the transepts usually lag behind the rest, there are many joints hereabouts where one section was built later than another: particularly where the two arms share the one buttress. Transepts are therefore fruitful sources of information. In the nave flyers the first arch over the spokes is a half segment

g



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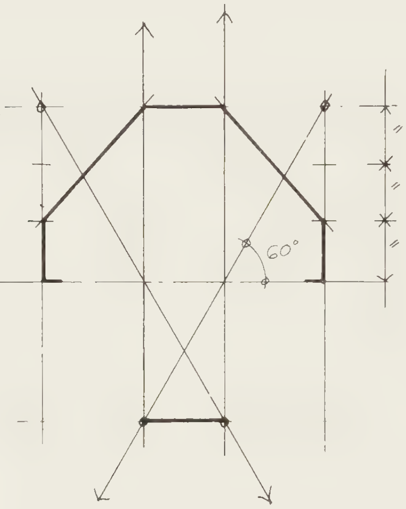

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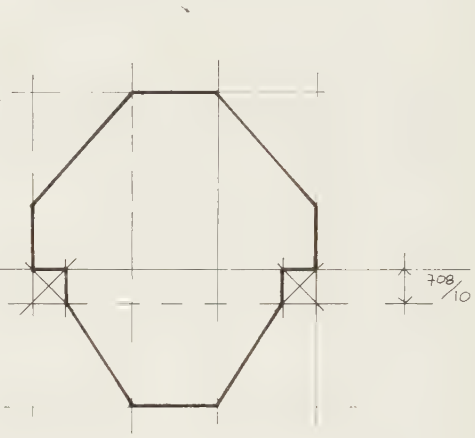

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61. For the sanctuary arches see X:43. In setting out the windows in 1211 Ruby also began the mullion. It is not like Rose's in GEOM:X-E. Ruby formed his inner circle in **g** as one seventh of the triforium wall thickness, wall + passage + arcade as in GEOM:XII-D. Squares were drawn from the outside of the circle, and a triangle on the inside. The overall depth was then one tenth of the bay. I think the figure was more likely to have been constructed as I have shown, with the depth as an added benefit, as the square-and-triangle construction is far from easy to accomplish working inwards from the extremities.

In **h** 60° angles from the inner corners position the faces of the mullion. The inner splays lie along the line that joins this face to one of the third points of the side. In **i** the glass rebate was made from a square measuring one tenth of the depth of the mullion, or one hundredth of the bay, and as for the inside splays the outer ones came from joining the outer face to the edge of this rebate.

Master W.G.'s fifteenth century notebook (Bucher, 1968, p.54) also shows that mullions could be evolved from the wall thickness.

62. To understand the history of the roses combine into the one drawing the evidence from the lancet springs - n.6, the frames around the roses - n.5, and capitals in the flyers - n.57, with the small capitals and corbels supporting the arches over the roses - n.63. Take the trouble and the results are obvious.

63. In **j** the sketch shows the relationship between the stones at the centre of the nave rose R. The small capital C finishes the top of the respond on each side of the window, and matches another on the inside. As you can see in the section **k** the arch over these caps is placed with the rose, and the vault cells V rest on it. The next arch A is a heavier one, and with its drip mould D rests over the first, and springs from corbels B against the wall. The base of the facing shaft S is added over this, and butts up to the top stone of the coping P over the flyers. In the choir and the transepts the rose is set a little higher and the base a little lower - so the order of the work is clearer. In the nave where they are at the same level the vertical joints show what happened.

I. *Capitals on the centre of the rose.* In **l** the capitals are by Cobalt in the nave, and Olive in the choir. Cobalt's are by *Multi, Bumps, Helmet* and *Dredge,* and Olive's are by *Squelch, Crease* and *Lapwing,* L. Bronze's *Bubbles* is marked U and Rose's *Piker* I.

II. *The corbels* in the nave have the same shape, and from the leaves some are Cobalt and others Ruby. Ruby's includes one with the same ladder as he used in the north porch piers - III:39, and in the north nave triforium cornice - XII:6. Their shapes drawn along the bottom are attributed consistently with those used in

j

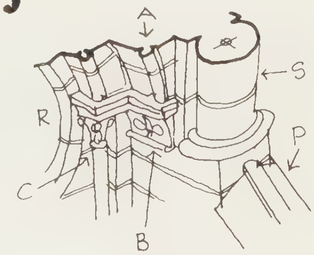
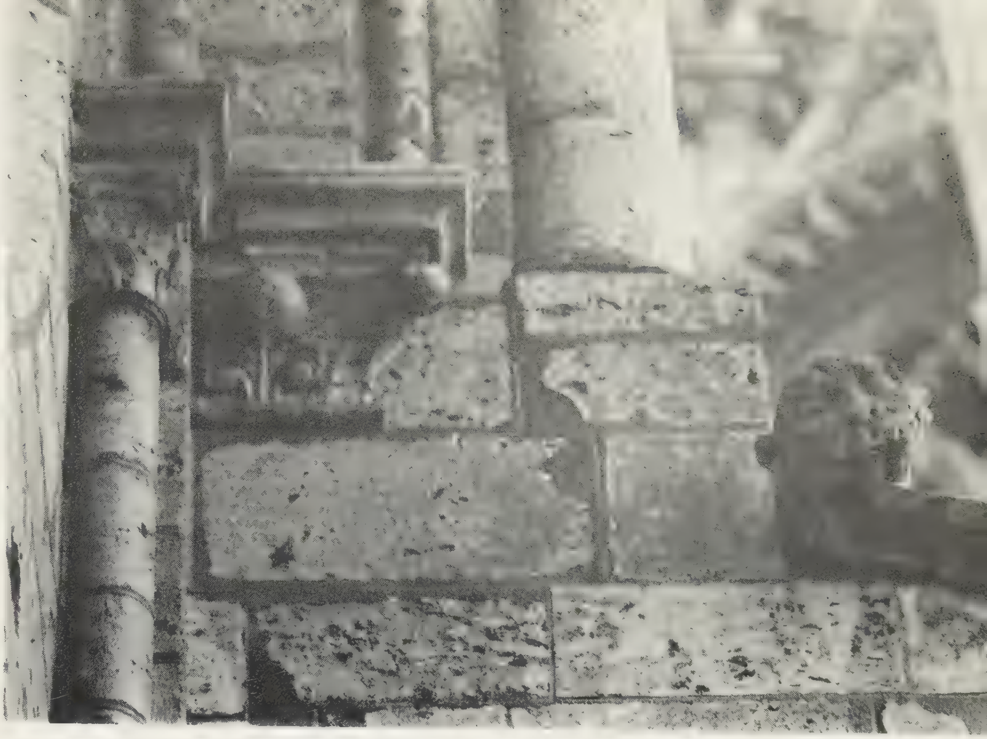


PHOTO 461: The respond capital, corbel, pilaster base and coping head discussed in n.63. These are on the north side of the nave.



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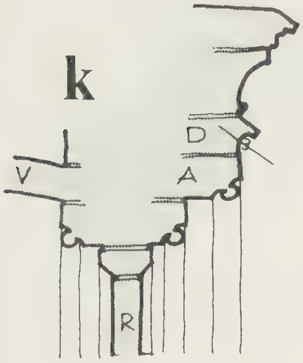

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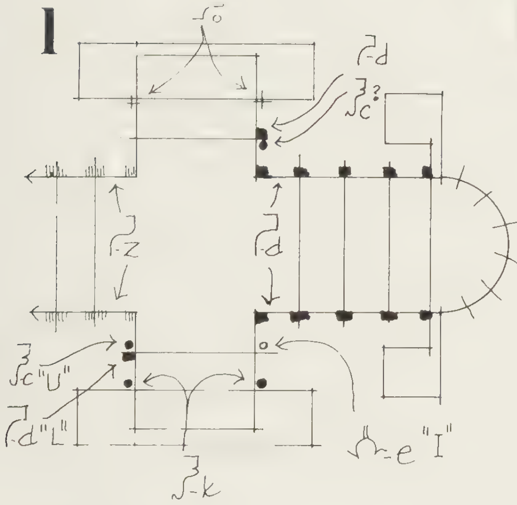

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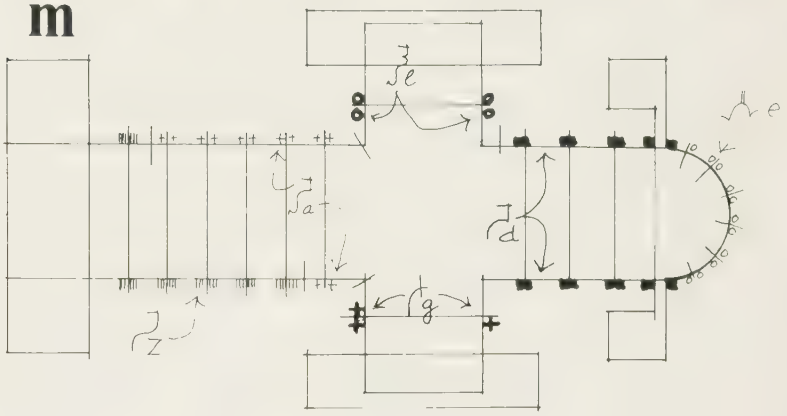

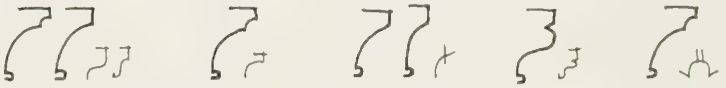

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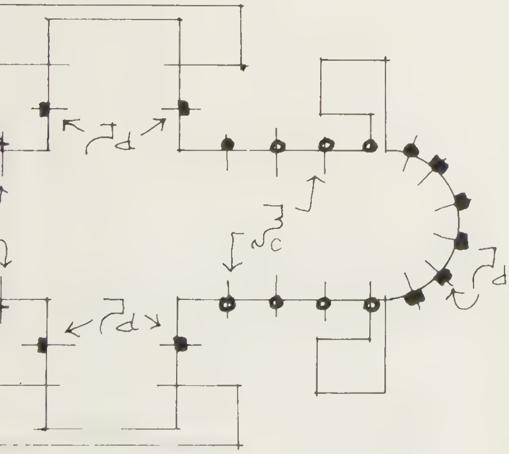
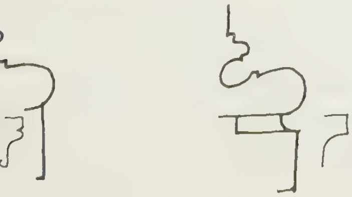




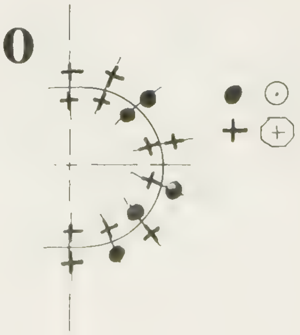
the cornices, including the roof XIX:10. The impost moulding is only used in the nave and crossing piers.

Olive-d's work in the choir is by *Squelch, Crease, Lapwing,* and *Spirex.* The higher corbels under the apse lancet arches by the same gangs shows the extent of Olive's campaign, and suggests that he began his work just under the centre of the roses, and finished with these corbels in the apse some four courses later.

III. *The bases under the shafts.* In **n** they are either the simple ungrooved ones which could be either Ruby-a or Bronze-c, or they have the more stylised groove of Olive. In the choir the base was always placed under and before the capitals. He continued the same alternation of octagonal and circular shafts begun on the ground floor - VII:13. In the apse the sequence of octagon and round shafts is not continued with the same logic. In **o** the circular shafts are shown as a dot, and the octagonal as a cross. On the outside they were placed sequentially starting at the south apparently by Olive-d. Notice the confusion.

IV: *The heads in the nave.* These were inserted after the column bases and are by Bronze-c - XI:24. Notice that there are none in the choir nor in the transepts, even though in the west transept the coping has the same shape as in the nave. See obvious joint at the top of SW.I.

o



sitting within separate stones which form its surround. But in the transept,[64] the arch A is cut out of two stones, and the upper one B is carried well into the wall like a cantilever. The messy coursing and the differences in the columns shows that there is a joint at the end of A before the next segment of arching. The unique stone B suggests that much of the upper part was built first. But why should the transept wall be built before the adjoining arch? Was the nave buttress and flyer only partly built at this stage so that the lower half of the SW flyer had to be omitted? This cantilevered arch is a tricky piece of construction, and I find it hard to believe it would have been done without a reason.

At the bottom of the arch D the flyers from both nave and transept meet the same buttress. The top of the spokes on the nave side finish lower than those on the transept E. Therefore the upper transept column C must have been placed before the arches over the nave spokes, as otherwise the arches over the outer transept spokes could have been built with the upper. Further, the details of column C are those of Ruby, while the lower four columns are unique in their simplicity, and would appear to be the work of Jade.[65] The joints to the inside corner of the buttress suggest that the order of construction is like this.[66]

Therefore the lancets of the nave and transept were built at the same time as the inside spoke, while the outside three spokes were delayed until after the nave arches had been stabilised. The outer spokes were built with the middle nave arch. The middle transept arch B followed completing the flyer. The reason they went to all this trouble would seem to be that the panel of walling above the lancets was built to resist the side thrusts from the main arch of the crossing. Even though this arch had been restrained with a wooden tie at the springing, it would still have tended to distort into a three-pin arch just where it meets the lancet arches.[67] Therefore the reason for raising the SW.I pier was to stabilise the

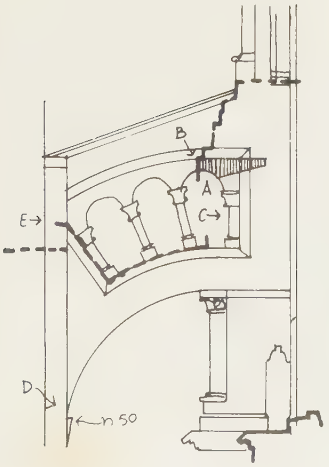
64. The corner buttress that receives the arches from both the first nave and the adjoining transept vaults was not built in the same way as the others. It was held back a considerable amount, in keeping with the delay to the SW.I clerestory pier. The two bottom courses of the transept flyer arch in n.50 which do not align with the other voussoires would have been laid by Bronze-X, and they and the stones which encase them coincide with the adjoining arch to WS.I, see n.49/a.

As the mouldings underneath are Scarlet-V there was a pause of one campaign here, or we could say that 3½ courses were laid in the three campaigns between V and X. As Cobalt-Z carved the capital under the SW.I springing, the upper part of this flyer arch must be his too. By following courses and looking for other signs of a change in contractors the gusset over the WS.I arch could be his too.

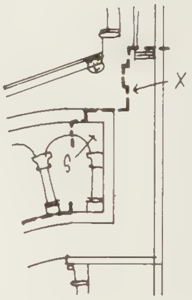
As there are joints over the top of the eaves course of the ostium roof, itimised in n.49/**u**, Cobalt's work seems to have met Scarlet-Y's there. This joint is a lot higher than the flyer arch springing, so a hole must have been left on the inside north-east corner of the buttress. This would have been easy enough as that part of the buttress is small, and the stones could have been inserted as the voussoires were being laid up.

Joints in the coursing and changes in the alignments of corners show that Ruby-a laid the SW.I gusset and the spoke capital next to the windows, and at the same time the arches over the WS.I spokes, mentioned in the next note. Jade-b finished the SW.I spokes and arches, n.53. The NW.I corner buttress follows a similar story.

Why was this part delayed? The cranes were set up in this corner, see XIII:32 etc. There would have had to have been quite a sizeable platform at the lifting head for the unloading of stones, their sorting, and for other materials needed at this level. Also the crane was not delivering to one level only, but to two or more as the perimeter buttresses were at a lower level than the clerestory wall, and both were higher in the west than nearer the crane. Secondly the choir was not as advanced as the nave, and consequently the first bays of the transepts which depended for their pace on the slower section, were also retarded on the eastern side. This is why the NW.I buttress was lower than its neighbours in the nave, being built more in step with the NE.I. But what of the SW.I? This pier was left at the level of the walkway for 5 campaigns, Red to Bronze - n.23. The special delay here was due, I think, to the gangway that gave access from the crane to the temporary roof. Very heavy timbers were needed here, some of them 8 meters or more long, and the materials for covering the temporary roof be it slate, tile, straw or lead. These materials could have been manhandled through the nave clerestory wall as long as it was low, say up to Cobalt-S, but thereafter would have to be taken around the working area. Also this provided direct access, by the shortest possible route, from this crane to the choir. Here is positive evidence in the building program for the temporary roof, that shielded the clergy from the mid 1210's to the mid1220's when the high vaults were completed.



65. See n.57. Where the arch meets the buttress the gusset is not set true to the arch. The coursing shows that the arch was built with or after the gusset on the nave side. The transept gusset was therefore even later. There is a putlock hole in the bottom of the latter.



66. The order of work in the crossing is not easy to determine. The western arch had a wooden tie across it, and could have been set in place just after the capitals with the lowest voussoires, or somewhat later as shown in the isometrics. The tie over the one bay only shows that whoever set up the western arch had nothing to do with the other three. If the arch was begun with the *tas de charge* in the adjoining bays, the lower stones would have been self-supporting. The formwork for the rest would have come later, as there would have been no point in building the fragile arch high above the surrounding walls, and leaving it there for five years while these walls caught up.

Also the peculiar construction in the two transept piers indicates when this arch would have begun to exert a side thrust, and if the arch had been built earlier this buttressing would have been needed earlier too. Therefore at this stage the crossing arches and the walls filling in between them and the clerestory were less advanced than the clerestory itself.

Years later when Rose-e erected the vault sideways thrust from the crossing. The necessary counterweight to this thrust was provided by the upper section of the flyer and its cantilevered arch. A neat solution to a difficult problem.[68]

On the eastern side of the transepts the flyers are more like their neighbours in the choir. They were completed a few years after, with the same thin section as the choir, except that the spokes are adorned with capitals and bases. A number of historians have remarked on them, and have thought they were an attempt to make them more like the ones on the nave side in case they could be seen from the street in front of the transepts.[69]

From this they have argued that the towers were an afterthought and were not begun until after the flyers had been built. But the chronology of the building shows that when the spokes of the SE.I flyer were being placed in the set-out for the adjoining tower had already been begun -not just in the triforium but in the clerestory itself. At that time the towers were not only intended but were partly up. The master may have felt that the flyers could have been glimpsed through the tower openings, or if not that there should be some sort of unity across the axis of the transept.

In the southern flyer the spokes were built by Rose using a sway-cut corner to his bases, and a simple impost set square to the arch rather than diagonally.[70] The columns are not carved out of single stones, but in short pieces which had to be joined together with metal cramps. Altogether it is more decorative and more slovenly than Cobalt's.

In the north the spokes are also articulated, but with their bases and capitals set diagonally. The impost is more complex and the limestone heavily veined. More fascinating, the size of the splay to the arches over the columns dictated a certain impost size, which in turn determined the size of the base. Set diagonally the base would have overhung the edge of the lower flyer arch, and the corners were therefore cut back. The irregular

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inside the crossing, before those of the choir and the transept, these arches and their walls must have been raised to roof height in order to support the roof over the vault, raising them a meter above the choir walls. So during these campaigns the encasing walls of the crossing must have risen much faster than the rest. Consisting simply of four arches and the thick walls between them, this would not have been too difficult.

As can be seen in n.76, the inner spoke and adjacent wall-acting-as-buttress was by Ruby-a. Hency Ruby was building the transverse crossing arch, using the same section as he had used in the aisle arcade arches. It may have been begun in the previous campaign, but Cobalt's work in the aisle vaults showed he did not think much of ties under arches - XI:48. There is even the possibility that the arches were begun with the *tas de charge* in the adjoining bays, and so by Ruby-W.

In any case the arch is Ruby's, whose love of ties is amply illustrated in the nave aisles. I would then presume that the other three crossing arches would be the work of Jade-b in the formwork, followed by Bronze and Olive in laying the stonework and the thick abutting walls.

I am convinced that across the rest of the nave the rib arches were not built at this stage as they were too slender, and for the reasons given in XIX:15 and following text. I am reasonably convinced that the transverse arches of the nave were not built at the same time as the arches of the crossing because

(1) there was no need to, the diagonal ribs being unbuilt,
(2) they were too thin, being only 460 across, and so would have been very unstable until held by their cells,
(3) there is no walling between the arch and the clerestory wall, so they would not have stabilised these walls,
(4) they would have hindered the carpenters raising and erecting the massive roof beams, and
(5) would have had to remain exposed to the weather for 3 or 4 years before the roof cladding was in place.

So, in summary, why would anyone build them at this stage?

The large arch over VIII, equal in section to the one over the crossing, may have been built at this time, but I have not shown it in the isometrics as I see no constructional purpose at this stage, and because there is no abutting walling as in (3) above.

In other buildings I have examined, particularly in Southwell and Durham, great efforts were made to complete the thick arches around the crossing as early as possible, even pushing the centre well above the rest of the works by many meters. Structurally its completion locked the upper parts of the building together, creating four distinct and securely encased zones, within each of which their roofs and vaults could be built separately, without relying on the others.

67. n.53/a. Compare with ties in aisles XI:49.

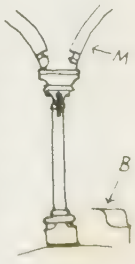
68. In the three eastern bays of the nave there is a similar vertical joint from this segment of the arch to the centre of the rose showing that there was a delay between X and the upper arch. It does not necessarily mean that there was a clear break between the two for the arch need only have been 2 or 3 courses below the wall to produce this effect. The reason for the joint was that the whole wall was being built to the same height, while the eastern three flyers were somewhat retarded - as can be seen from the capitals in n.57. In some cases the first stones of the arch over the spokes is set into the wall a little, but not to the same extent as B in n.64.

This and the more advanced state of the north compared to the south, reversing the position lower down, is because Olive had been prevented from continuing the cornice over the triforium in the western end of the nave. He had been permitted to bring the eastern walling up to the same level as the west just under the corbels over the triforium passage, but the rest had to wait on the decision on the competition for the clerestory. The tilt in the nave was therefore eliminated, the west was no longer higher than the east. This is why we find that the nave clerestory wall was being built course by course across its entire length.

Though the plinths along the perimeter triforium walkway were laid together, as the buttresses were built the west again moved a course or two ahead of the east. Due, I think, to the position of the crane by bay II imposing the same restraints on the parts nearest to it as it had in the aisle vaults - see isometrics. By the time they were ready to lay up the flyer arches the eastern buttresses were delayed by a course or so. This was exacerbated by the decision to form for only 3 flyer arches in one campaign, two in the next and the remainder in the third. Were they economising on formwork? I doubt it as the altered radii would have compelled them to rebuild this formwork. The result was that the eastern clerestory wall was higher than the corresponding part of the perimeter, and so vertical joints were left to enable the wall to continue while the outside caught up. It is interesting that though they were compelled to make some peculiar junctions they made no attempt to either hurry the buttresses or to delay the walling to keep them in step. They preferred to proceed at whatever the natural pace was for each part, and to take care of any difficult junctions as they occured.

69. Frankl, 1957; Grodecki, 1958, etc. See discussion of Symmetry in VII:13 *et al.*

70. The bases have splayed corners B with the top edge rounded as Rose used in the S(cw) - XIV:26 - the caps have a projecting bud, like the crockets to one of the caps to the EN.II(t) room facade, and Rose-*Twist*, XII:32. So it could be Rose-e. The arches finish square over the impost with a moulding M under the splayed edge typical of Rose's earlier work - VI:45.



octagon which resulted was not limited to the base, but was extended right up to the capital itself.[71]

Yet in spite of the obvious care there is a curious error in the arches. Instead of each half arch being built out of one stone, there is an infil like a keystone which flattens the apex of the arch.[72] The rest of the arch is identical to those over the choir. Why then the infil? A larger piece of stone would certainly have been used for the whole arch if the templet had been cut to the right size in the first place. Perhaps he ordered the templets to be made from the adjoining flyer before he had raised his scaffolding high enough to check? or maybe he forgot that there were only to be three arches in the transept compared to the four in the nave? Who knows?[73]

Within three such dissimilar designs for the flyers, over only a few years what of the Master of the Works? Was there one man, or a limited succession of men who designed the building in full and saw that it was carried out? These three flyers are only one among the many things I have described which show that there was probably no professional supervision that continued beyond the engagement of each crew. The clergy seem to have imposed no more order on the works than an untrained but intelligent client would today.

In many of the smaller buildings of this time like St. Pierre nearby there is even less unity than at Chartres: there was only a token respect for what had gone before. The smaller churches may not have had a permanent administrator controlling the fabric and its funds. In the larger establishments it was essential to appoint from among the clergy a master of the fabric to supervise the multitude of construction and repairs, and to arrange for the payment of the permanent building staff.

Thus it would fall to the administrator to ensure a relatively homogeneous building. Laon is an excellent example of good administrative supervision - for at a first glance the building which took over eighty years to build looks all of a piece. However when we look in detail only

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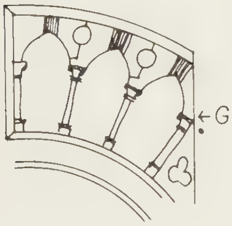
[71] The impost, base and caps remind me of Ruby-*Pawn* and *Hats,* in program 'h' and this fits the order of work here. Remember he may not only have been following the choir spokes in his diagonal shafts, but may also have preferred the idea as in the north porch pier shafts and the aedicule layout.

[72] The vertical joints between the shaded key and the other parts of the arch shows it was not intended, for the stone would have fallen out if it was not dowelled. The use of such a non-structural arrangement suggests an infil.



[73] Compare the NE flyer to the SE by Rose, where there are no infils. The arches appear to be set to a slightly wider geometry and the spokes are shorter than in the choir, visible where the spoke and the gusset meets the buttress. In the SE flyer the gusset was placed before the spoke, for the impost is 250mm below the meeting place. The use of only three arches instead of four produced a more open spacing, even though the transept bay is 1,140mm narrower than the choir. In the south Rose compensated by lowering the springing line, but in the north the problem was not understood until too late.

a. The lower arches in the choir flyers grow out of a small horizontal moulding so that it and the splay under the arch can be carved from the one stone. In both transepts the arch starts higher up as the span is less. The lowest course has no splays, probably intending to make the transition further up. The joint is at the splay.
b. In SE.I the outer spoke projects into the buttress, showing the location of the joint.
c. In NE.I the upper arch on the choir side comes out of one course in the buttress, and the arch to the transept in the next. Once the gussets were placed the spokes and the upper arch can be laid as convenient - n.45. This is why the upper arch to the choir could be built independently to the adjoining one to the transept.
d. The voussoires on the extension of the EN.I arch from the pier to the NE tower are not bonded into the pier. This is the only example. The butt joint shows that the rest of the flyer with its spokes could have been erected before the extension of the arch to the flyer. Its coping is also butted.

A comparison between n.30 and XVII:27 will show that this arch was by Jade-g, supported on the nearby corner of the NE tower that had been especially pushed ahead of the rest of this tower. The inner arches of the flyer with their spokes had been the work of Ruby-a to Bronze-c. The extension of the flyer was left out at that time, and was no embarrassment to them until they began to load it when the choir vaults were being put up. These vaults are the work of Bronze-f, and at the same time, recognising the problem, he added at least seven courses to the corner of the NE tower. His successor Jade-g added another six courses and the arch, while he was placing the cells of the vault. If it had not been possible to push up this corner of the NE tower to support the flyer, I wonder if they would have delayed the construction of the choir vaults?

[74] Richard King has analysed all the mouldings inside the building and has shown that small differences between superficially similar mouldings do indicate changes in crews. As in Chartres, Laon was built in layers, not in sections.

[75] Branner (1973) wrote that I believed "that Chartres was *conceived* as a group project in 1194", p.329. This was certainly not so. I have little faith in committee architecture. However I fear that a number of scholars have accepted this as my view, and I should set the record straight. The evidence from Chartres shows that in nearly all minor matters (cornices, final dimensions, doors and windows, buttress shapes, etc) the individual contractor pleased himself. The exception is of course the interior elevation. Here the contractor still made very small modifications to suit his own foot and geometry, but on the whole followed an agreed scheme. I think we can conclude from this that there was a document of some sort, drawn, written, or modelled, which set out the broad design features of the elevation, and every contractor was required to follow it. I believe this to have been the work of the first master, Scarlet.

But beyond the multitude of small items which fill most of the pages of this book, there are a number of major changes - in the arrangement of the architecture and in structure. These are the two aspects of any building for which the architect must be responsible if he is to retain the name of architect. An architect in charge of a project might leave the design of minor items like doors and mouldings to his builder, but how could he leave fundamental structural decisions to his men, or ones affecting the final appearance?

Omitting those modifications that seem to have come from the client - doubling the ambulatory, the changes to iconography, the clerestory competition, and omission of towers, raising of roof and third flyers - in just the first 29 campaigns 21 of them suffer from *major structural or design changes,* sometimes both. I have not included in this list any master who may have begun an element, such as Ruby who began the single windows of the nave aisles with their sills. But even here how are we to know that his scheme followed the design the broadest perameters are consistently followed, within which we can still find enough individuality to isolate the identity of most of the crews on the job.[74]

At Chartres it seems that apart from approving or instigating obvious changes such as doubling the ambulatory or changing the clerestory, the client only bothered to control the interior elevation of the cathedral and the overall silhouette. Unpalatable as it may be to modern well-disciplined thinking, the early Gothic cathedrals grew as they went, with little more direction than a generalised briefing from the client, and of course the work that had already been built. The latter would have been in nearly every instance the most important influence on the masters, as is amply illustrated in the flyers.[75]

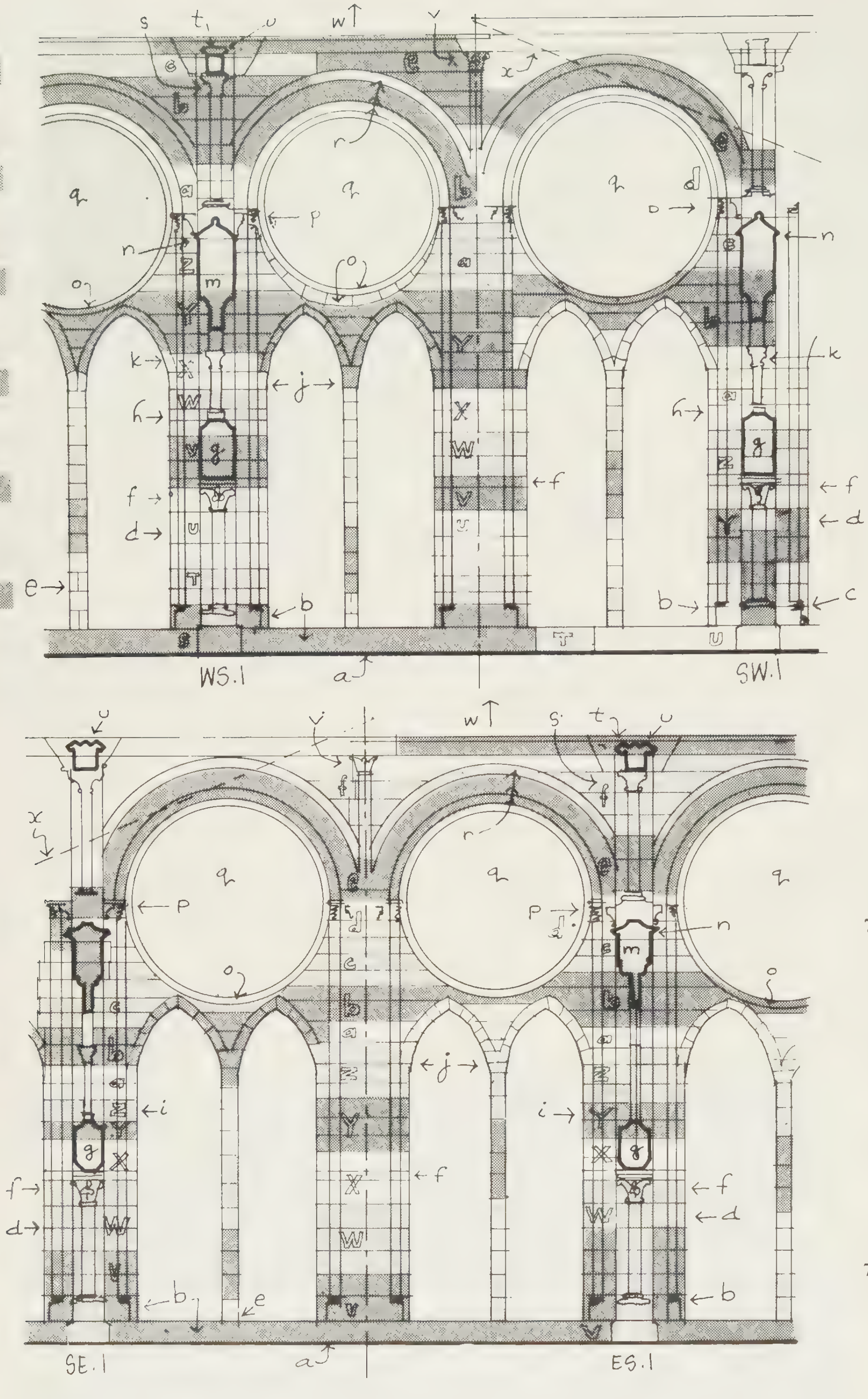
Now that I has assembled all the data, and have drawn it in plan, section, elevation and isometric - there are places where all four were needed before I could see the solution - I feel I can now summarise the work in the two clerestories. Between the last corbels over the nave walkways and the cornices under the roof there are eight crews. I knew their identity from elsewhere and had collected pretty hefty dossiers on them. I could then use the same technique as elsewhere, and by fixing firm positions I could subdivide what lay in between. This enriched the dossiers and gave me a lot more material with which to play 'consistencies'.

Clues collected in the lower work seldom presented themselves in the same way above the triforium, and it became an enormous job to assemble and collate almost three thousand details. To be effective it had to be a complete collection of the *metier* of each master. There are obviously problems stemming from the analysis of only one building, but when it can be extended to others in northern France it could become a Debrett for the Gothic period which will help students to identify each crew wherever he might appear in other parts of the country.

first proposed by Scarlet? Ruby may have been the originator of these windows, and Scarlet may have proposed (or only intended, if not shown on the model?) another solution altogether. Indeed, there is some evidence for this as in the sanctuary Scarlet altered the Ruby sill into a cornice so he could install a walkway outside the windows. If he did this in the choir may he not have intended a walkway all round the building? If so Ruby's use of long sills would be one more item to add to our list of major design changes. If each of the changes listed below represents a change in architect, then lets do without him, and return to the master-contractor under some sort of client control. Here is the list, many of which will be enlarged on in ch. XXII.

Bronze-B: straightened axis, VIII:18,33; altered bay centres, added porches(?) and enlarged crossing, VIII-A.
Rose-C: rebent axis at crossing, reduced crossing, and width of transept by 1½ meters, VIII-A.
Bronze-E: circular columns in sanctuary, new bases, VII-D; narrowed embrasures, XVI:E7.
Scarlet-G: walkway in sanctuary instead of sill, VI:52. South porch pier unlike north XVI-A.
Bronze-H: double windows in choir, X:12.
Ruby-I: altered the geometry of E.IV buttresses, X-D.
Cobalt-J: new buttress shape between chapels, IX-C.
Rose-K: east sanctuary buttresses changed X-C.
Bronze-L: north lintels unlike south XV:24.
Ruby-M: SW(p) buttress geometry unlike SE, III-D. Vertical geometry in triforium, XII.
Cobalt-N: realigned axes in nave buttresses, XII-H.
Bronze-O: changed footings under choir triforium cross walls, XII:14.
Scarlet-P: the octagonal choir pier, XII-E: steeper triforium roofs XII:35.
Olive-Q: replaced stone roofs with wood in apse XII:38.
Cobalt-S: omitted colonnettes in nave buttresses, XIII:6.
Ruby-W: replaced ostiums of nave with aedicules, XIII:47. Thin flyers XVIII:58.
Bronze-X: reduced height of vaults in locating lancets, ISOM-X, XVIII-E.
Scarlet-V:N(p) buttress unlike south, XV-A.
Cobalt-Z: trefoil gusset and unarticulated spokes in choir, XVIII:45. Alter plan ES tower, XIV:8.
Jade-b: SE(cw) tower plan and cornice different to east, XIV:26.
Bronze-c: Omitted shafts under ribs inside towers, XIV-D.

*PHOTO 465: Capital over the choir clerestory walkway by Ruby-*Eyes.



76. *Elevation of the nave and choir clerestory walls taken at the SW and SE corners so that the adjoining bay of the transept is shown.*

a. Walkway cornices - n.10.

b. Sills, bases to responds, buttress plinths and the bases to their shafts - n.21. Choir has same rollmould as Scarlet used in the nave aisles - VI:73.

c. Joints at SW.I - n.22-3.

d. Corbels over passageway - n.29.

e. Mullions n.61 begun by Rose in the nave, for there are perpends. There are no perpends in the choir though one mullion has a tumour - n.8 - and if by Rose suggests a changed technique between 1214 and 1220. Others are guessed. However if Rose-e did NE.I and the lancet arches come in the next year, we should apply the same rapidity to the nave, and let Bronze begin them. Difficulties, especially with X:43. We need this arrangement for consistency.

f. Capitals at the springing - n.53. The thin course is impost. Notice how the crossing is delayed.

g. Tower flyer arches - n.30 and 49. SW.I flyer in n.64, 67. *Tas* in n.47.

h. Inner spoke base in nave and SW.I - n.57.

i. Choir spokes Cobalt - n.58/c. For SE.I transept Rose-e - n.70. NE.I probably Ruby-h. Section n.49.

j. Starters for lancets n.6.

k. Capitals to nave spokes and SW.I - n.57, with Scarlet's heavy arches over them. For construction of SW.I - n.67.

m. Middle arch of nave begun by Scarlet over 'k', and by Bronze in the choir with a moulding like his corbel.

n. Copings begun by Ruby-a in the nave, Olive-d in the choir with 'm' - XIX:14.

o. The frame under the nave roses begun in the west by Scarlet, and altered in the first bay by Cobalt who changed the ellipse into a smaller circle - n.62 and text.

p. Capitals, corbels and shaft bases alongside the centre of the rose - n.63. Heads in the anve XI:24.

q. Rose windows, n.5.

r. Arches over the roses in three courses plus rosettes in drip. They have been assigned as convenient. Rosettes may be the idea of Bronze begun with his head in WN.VII -n.35.

s. Capitals over shafts, imposts, blocks and cornice - XIX:10.

t. Upper flyer arches - XIX:12.

u. Copings over upper flyers - XIX:14.

v. Corner caps probably Rose in the west and Ruby in the east.

w. Roofs begun by Bronze-c and Ruby-h.

x. Temporary lean-to roof over the first transept bay - XX:34/h.

77. Reasons for placing western nave before the east:

a. 4-foils in ostium gables and pinnacles over - n.49/g and XII:38/V.

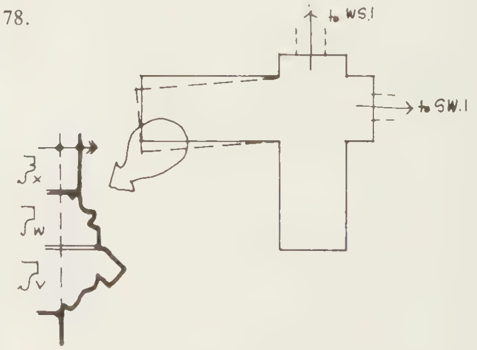
b. The geometric forms in the pinnacles are on the upper gables in the west, and on the lower ones in the east.

c. The middle flyer arches are bonded into the wall in the west - n.68.

d. Some of the responds round the windows are *en delit* in WS.VII, VI and WN.VII, and the lengths built in this way reduce towards the east.

e. The radii of the lower nave flyers - n.49.

78.



79. This coincides with the suggestion in XIII:28.

80. See n.53/e and f. See also XX:29/e.

In the drawings[76] I have shown the work done by all the crews in the corner bays of the southern transept. As the western end of the nave tended to be a little ahead of the east the crews shown here are seldom those who actually began the elements, and for those you must refer to earlier drawings.[77]

It must by now be clear that one of the most important consequences of their contractual methods was that little information was left for the next crew. They had to prepare their designs and cut their templets without any of the previous masters' documentation, or even a corpus of information collected by the clergy as the work went up. There is enough evidence to suggest that there were models of a sort, or drawings which acted as general guides: probably no more detailed than a presentation set used to explain things to the client. How much the clergy actually knew about some of the changes being made by the masters of their buildings is problematical, though some day we may accumulate enough information to discover what sort of personal relationship the client had with his contractors.

But one thing we can see with certainty - that the newly arrived master had little if any contact with his predecessor. For example in the big corner buttress which supports the flyers to the nave and the transept,[78] the two arms are not square to one another, because the walls underneath are not. Scarlet and Ruby built the lower part of the cornice to suit the correct angle, but the next master cut one and a half meters of masonry to suit what he thought was a square corner, and did not discover his mistake until he began to erect the stones. The bend in the wall can be seen quite clearly from below, and this in spite of the fact that Bronze had worked here on this very section nine years before - or is it another indication that the man in charge of that crew had been replaced?[79]

In another case Jade cut a capital for a circular shaft when the *en delit* stone under it was octagonal. This is the main vaulting arch in SW.II. Some five years later Green did the same thing in the north transept.[80] This was Green's first appearance on this site, and I would have expected him to have taken a little more care, especially as over NW.III he seems to have not only carved a circular capital, but to have set up the circular *en delit* column under it as well, in spite of the fact that this one is also octagonal lower down.

Whatever the explanation in each case, there are enough of them to show that one master was unaware of the modifications or intentions of an earlier one. The continuous changes in geometry, fundamental as that was to their design process, and the endless changes in detail bear mute witness to the endemic confusion of the building scene. It was only the masters' immense respect for work that was already in place and their implacable reliance on geometry which permitted them to build anything so worth while under these conditions.

The moment a new master arrived on the job he would no doubt send his carpenters around the building to measure and make templets for all the unfinished standardised elements. This would have been quite straightforward for they just placed their piece of birch planking over the last stone laid, and drew the shape directly onto it. Thus work could proceed on some parts of the building while the master thought out the specific problems left to him. The geometry for each new element in the building was a unique exercise, related to the conditions which prevailed around it. This made detailed drawings unnecessary for anything except the major considerations of plan or elevation.

For example, if he wanted to spring an arch between two piers he would set out the curves on the working platform itself or on the floor below to suit the actual column centres as he found them. The uniqueness of each situation was thereby fully expressed. The mistakes came when small misalignments were not noticed, and no-one warned him to be careful.

The evolution of a great Gothic monument was fluid and organic - it was a process rather than an act, where the decisions came from the immediate situation rather than from an exactly completed plan. The building was a concept in time, for the work of the moment, element by element, was the major governing reality. The completed cathedral is like a biography, for only when a man dies can we sweep over his life and see it whole. Only when the building is finished can we stand aside from the process to take in its entirety, and its accumulated meanings. Up to that point building and architecture are just the flux of a movement in time.

It is like the growth of a tree from a small seed. We know, and perhaps in one sense the tree also knows, the idealised form it is intended to have. But the accidents and experiences of growth, however rational and causal, will alter the ideal to the particular. A dark shadow will force the tree to lean outwards, a stroke of lightning will shatter a major branch, a boys cubby will modify its natural order. Thus the great cathedral, like the tree, evolved from the generalised concepts found in the model and in the minds of the times, into a rich and particular personality.

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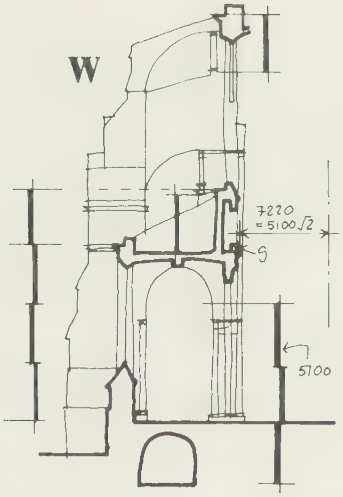

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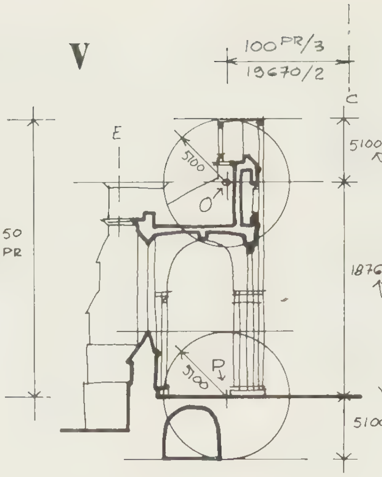

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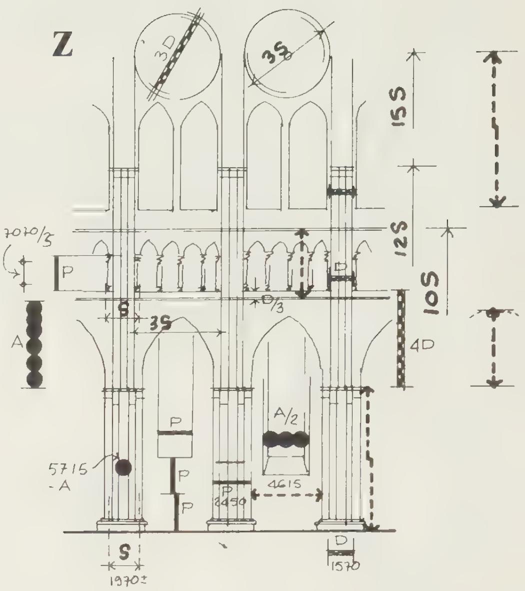

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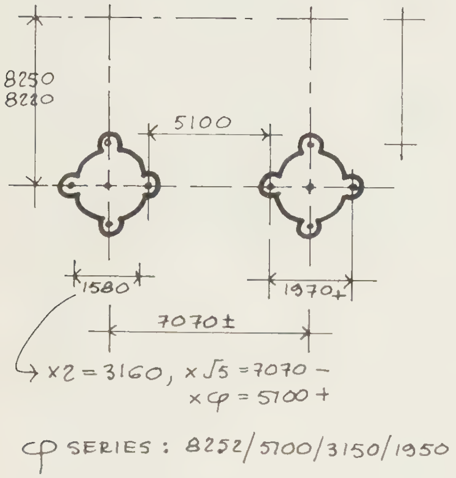

Geometry XVIII-F

The use of modules in the elevations.

The same lengths seem to recurr at all levels of the building. In ch.XII I showed how the builder would take dimensions from the ground level to use higher up. Cobalt picked interior axes for his geometry, but there are few critical vertical measurements by him to allow me to judge his use of modules. Olive and Rose returned to their own foot units when in doubt, and again there is little information. Red, Jade and Green have left even less for us to go on. This leaves three masters for whom we have sufficient decisions to discuss their use of modules.

Scarlet hardly ever used them, except the depth to the crypt which recurrs fairly often, but seemed to derive more as √3 times 10^{RF} than as a module. Even the fifths and ninths of the bay and span in GEOM:VI-A are more like steps in a process than modules in their own right.

Bronze returned readily to axes, be they pier, shaft S or H axes. He did use modules from time to time, but even with the spacial series used to position the arcade caps I feel they recurr more as representatives of φ and its brethren than as modules. This is not to say that neither of these masters derived any heights from the plan, for all the geometric studies in this book show that they do. But between the act of extracting the unit from the plan and its application to something in the elevation lies an intermediate geometric step.

Only Ruby often utilised the plan measurements directly and without modification, and did so in most of his geometries.

The most important, and the one also used by Bronze and Scarlet, was the height of the crypt, being 5,090-5,110mm. It was first employed by Scarlet in positioning his footings in 1194. In XI:6 you can see that he calculated *ad triangulum* from 10^{RF}. He used it again in the flyers for the radius of the intrados of the lower arch **v**. See how a similar circle could be drawn to locate the aisle window sill.

Vertically this re-used the 5:6 ratio so often found in his work, though expressed through its sum of 5+6=11, producing radius:OP =11:3. Similarly in the horizontal position for O, which lies one third of 100^{RF} from the middle of the nave, and which relates to OE as 10:11. The height from the floor to O is equal to the distance from the middle C to E. The radius of the extrados is one third of CE, just as CE is 3/4 the height from floor to the extrados.

The second master to use the crypt module is Ruby, but in his case it represented one third of 50^{EF} at 5,093mm - XI:20. The occasions where he used this module are shown in **w**. The stilting of the arcade arches U is two units and by √2 gives the distance to the shaft centres CS.

Ruby used this module for the radius of the choir flyers in GEOM:XVIII-B, but did not use Scarlet's use of the same module in the nave. there he reduced it to 4,730mm to maintain the same distance as in the choir between their centres. Thus the horizontal distance between the centres were more important than the modules, it was also more important than the height above the floor. See discussion at the end of the previous geometry.

When he placed the roof cornice in the choir he located it this height above the centre of the clerestory rose, discussed in GEOM:XIX-B. Notice the settlement to the interior modules from 5,105 to 5,095 - GEOM:XVIII-A.

There is another module which relates to these. Remember that in ch.XII Ruby measured the space between the piers on the ground to determine the height of the triforium. The many dimensions between the centres and the shafts of the piers provided a mine of possible modules, and having been carefully designed in the first place, each of them would have recognisable relationships with the others. The relevant ones are shown in **y**, with a φ series which produces a third module, being twice the diameter of the pier drum at 3,160mm. Ruby used it in the squares which formed the piers of the triforium and the clerestory - GEOM:XII-D and XVIII-C. He used ten of them for FC in the nave -GEOM:XVIII-B.

Ruby further subdivided the drum module into halves and thirds for the parts of the triforium. Besides the drum diameter there is the distance between the shaft centres of 1,970-1,980mm, and the width of the whole pier at 2,445mm. Ruby used one of these for the aisle windows, one for the height of the triforium columns, six to the underside of his triforium cross-wall footings (2,445 x 6 = 14,670mm).

Others are shown in **z**, and there is also a module which nearly everyone used at some time or another (except Cobalt), which is to measure the bay but never the span, and to subdivide it into ten, twenty, or even fifty parts. Walls, doors, shafts and arches will all be constructed from it. This is the closest we come to a universal module, and the only one to come directly from the main axes.

Modules have a life of their own. They superimpose their own pattern over everything they meet. Ruby used them cleverly, and so avoided the monotony that lurks behind this technique - as modern architects know to their cost.

...XI-A/XII:25-31/XVIII-E/*/XIX-B...

NINETEEN

The high vaults

As he looked down the well of the tower, he could see how the vaulting had been rebuilt, so that only a circular hole was left through which the eye could find the dim pavement; so dim as to be almost invisible. But beams came up end on through the hole to where the workmen received them.

William Golding

On the fourth of June 1836 the great cathedral was again visited by fire. Unlike the one of 1194 this disaster was described by hundreds of people, the ruins were sketched and measured, and afterwards it was recorded in oils on canvases which now hang in the Bishop's Palace. They readily recreate the lurid glare of that aweful night, showing the tower of flames and sparks that turned the cathedral into a torch which could be seen for miles around.

The structure of the old roof had been of wood, and had been lined with lead. It was strutted and braced just like its smaller brother which still stands over the sacristy. The great beams were dry and cracked with age. Woodworm and beetle had opened many of them, rainwater and leaking gutters had rotted the ends, but after six hundred years they still held firm. Tall wooden pinnacles crowned the ridge giving the bulk of the cathedral something of the many-spired look it was once intended to have.

As in 1194 the workmen who had been repairing the roof left in the evening without making sure that their brazier was extinct, and in the high winds which blew up in the night the old timbers caught fire. Fire had been the greatest scourge of medieval building, and Chartres had been constructed solidly enough to withstand another. Its stone vaults were parged over with cement, and the walls were restrained with massive three-tiered flyers and an enormously thick revetment all round the edge of the roof. The fire slightly damaged the stonework of the gables, but otherwise the masonry of the building was unaffected.[1]

They proceeded at once to replace the roof, not with timber nor with precast concrete sections as at Reims, but with cast iron. It was the railway age when some of the largest spaces ever conceived were being similarly roofed, though Chartres may have the distinction of being the largest on the Continent at that time. Even so it took them five years to finish, showing that the nineteenth century was no quicker than the twelfth. A large cast-iron plaque was fixed to the inside of the western gable to describe what happened, but is now not entirely legible -and will be no clearer in six hundred years time than any of the information we have from the twelfth century.

From within the new roof is like a gigantic upturned ship, like a wreck stranded on the coast. The sun shafts through the broken windows and the pigeons flap noisily in and out of them. With a slightly damp smell coming off the rust-coated metal it is one of the most evocative spaces I know. Except for the birds it is absolutely quiet, remote and unreal. It is awesome: to stand within its gargantuan volume and at the same time to peer through one of the small holes through the vault boss down onto the cathedral floor thirty four meters below is unforgettable. You stand yourself within such a huge volume, and down there so far below are tiny people moving across a kaleidoscopic pattern of paving stones, chairs and lights. The dramatic perspective of the piers and arches converging on the floor and the great labyrinth set into it holds you spellbound.[2]

The French have a passion for roofs. Think of Chambord and of the Mansard roofs of Paris. The tremendous mass of the Chartres roof is one of the most important elements in its design. It dominates the faceted projections of the flyers below it, just as it is itself dominated by the limitless horizons of the Beauce

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1. I refer to the parts of the cathedral built after the first fire: the substance of this study. The main damage from the 1836 fire was to the inside faces of the gables which were heavily burnt, and much of their copings had to be replaced - XXI. In the older western end of the building the damage was more considerable. The timber structure supporting the bells inside the WS tower were burnt out, and the inside of its upper chamber was even more heavily charred than the transept gables. The heat was so intense within the WS spire that the uppermost half had to be replaced, and its seating reinforced with a concrete and steel floor to tie it all together.

2. The paving at Chartres is not level, though the footings under the piers and walls are. At the ends of the transepts the floor coincides with the footings, but in the sanctuary it slopes upwards some 250mm so that most of the eastern plinths are covered, and from the crossing to the labyrinth there is a dip of 200mm or more. Westwards from the labyrinth the floor slopes downwards a further 850mm to meet the threshhold of the Royal Portal. These levels have been discussed by Bulteau, 1901, iii, p.45; Frankl, 1957, p.43-4; and Villette, 1971, p.264.

The ends of the transepts were laid when the porches were repaired in 1900, and these are the only stones to be laid to a pattern, reflecting the 'octagon' in the footings.

Because all vertical geometry was taken from the footings, I think that this was the intended level for the paving. Though the paving stones used in the aisles of the choir may be thirteenth century, I am inclined to think that they were taken up and relaid to their present levels some time ago, earlier than Frankls' date of 1763. Relaid because there is allowance in the wall plinths in bay IV for three steps from the sanctuary to the chapels, and yet there is no sign of these steps alongside the sixteenth century choir screen - VII:32. So I concluded that the eastern floor was raised above the level of the footings some time between the completion of the cathedral and the construction of the screen. The finding of fragments of the *jubé* from under the floor east of the crossing shows that this section was relaid, and perhaps to some extent relevelled too, after the destruction of the *jubé* in the 1760's.

The sloping paving in the nave, on the other hand, may be original. In the earliest plan we possess, Felibien's of 1678 printed by Challine on p.135, we can see the medieval stalls and the *jubé*, and in the nave the steps separating the aisles from the lowered central vessel. The conditions are the same today.

The fact that there are steps between the aisles and the nave, and that the footings are so indecently exposed, suggests that this was not what was originally intended, and though there is not a great deal of evidence, I think that the floor may have been laid in a hurry to suit the urgent needs of the clergy when the lower temporary roof was being built over the nave in 1200 - VI:69. My reasons are somewhat circumstantial.

By pier IV the labyrinth was set into the floor in a green marble. The arrangement of the paving stones around it does not seem to have been disturbed over the centuries, and fits the pattern for the rest of the nave, suggesting that the labyrinth was laid with it. The dimensions and the geometry of the labyrinth in GEOM:XIX-A show that it was the work of Scarlet, probably in 1200 if this argument holds. This labyrinth is one of the most intriguing and mysterious items in the whole cathedral, and I have attempted an interpretation in James, 1977.

The reason that the aisle paving is higher than the nave is that the vault over the crypt prevented them lowering it along with the central portion. The reason for lowering the centre is, I think, to be found just inside the western door, the threshold of which lies just over a meter below the thirteenth century footings.

As Mayeux pointed out in 1906, there are signs that there had once been a vault just inside the western entry, set between the two towers. These marks are still visible on the inside walls, and they coincide with the bases for the small wall shafts still visible at D, and with the larger shafts attached to the transomes in the entries into the towers E. Along the inside of the west wall the two shafts marked C delineate a central bay wider than those on either side: a three-bay arrangement in the west with one larger bay corresponding to the larger central portal. This could have formed a 3 x 3 bay narthex, as shown in **a**. There could have been a wall at W, possibly with three doors through it.

However the Lefévre Pontalis (1900) excavations did not unearth footings in this position, but just to the east of E, and to the east of W. He dated them in the twelfth century, but there was some dispute with Mayeux (1904). The records of the excavations are far from complete, sadly.

The columns C are bonded into the western wall and their centres coincide with the centre of the external projections of the portal, showing that both were set out together. The measurements between the columns on the south side of the narthex exactly match those in the west, confirming the evidence of the exterior stonework that the portal was built with the WS tower - XI:2.

In this scheme W would have projected beyond the face of the towers, leaving a small space between them and the nave. The plan of the crypt shows that its westernmost bays do not adjoin the towers, but that there is a gap there too, laid in solid masonry, the east face of which coincides with the east fact of W. The wall W lies neatly over the footings found by Lefévre Pontalis, the only difficulty is that there are no footings under the positions where I have drawn the four isolated columns in the plan. What do we do about that? Instead there is a strip footing with engaged piers which would have supported two piers in this narthex, in line with those attached to the inside of the west wall, and with the engaged piers in the footing under the wall that would have separated the narthex from the nave. Was it finally built as a 3 x 2 bay chamber, with twisted bays along the sides? Or was there a staircase to the upper chambers? Frankly, I do not understand them.

The wall W would have been continued upwards to enclose an upper chamber, and because the glass of the three lancets survived the fire this chamber must have been totally enclosed in masonry, and with a stone vault. There may have been an opening between it and the nave, but it must have been fairly small, otherwise the glass would have been affected by the fire. But the glass would not have been easily seen from the nave: maybe this chamber was built as an Easter Resurection chapel, see Libby Parker, 1978.

If this theory is correct, and I have assumed it is in ISOM-A, then this wall and the eastern bay of the narthex would have been demolished in 1194-5 to make way for the end piers of the new work, shown dotted in the plan.

They did not demolish the whole of the narthex, for there is evidence on the inside walls of the towers that the western two thirds of the floor of the upper chamber remained until the sixteenth century, or later. These walls are now a mess, showing all the signs of a partly completed demolition job. Starting from the springing capitals of the high vault and working downwards, the shafts under these capitals had been installed in the thirteenth century, with the same backing wall, and the same supports and *en delit* shafts in between. The metal dowels which held the *en delit* sections are still in place, projecting through the key stones, showing that at one time the whole assembly had once been complete. The few remaining portions of *en delit* work indicate that demolition was interrupted before they had finished pulling them all out. There was a change in orders.

Lower down just under the line marking the edge of the narthex vaults, new arches had been built decorated the post-Gothic egg-and-dart mouldings - n.33/d. The columns in the western corners of the narthex are also of this date, so my theory is that at some time contemporary with the egg-and-dart moulding and before Felibien drew his plan in 1678, the old narthex was removed, possibly to make room for a new organ loft across the western wall. There are many examples of this being done elsewhere at this time, though it invariably blocked the light from the western windows. It is tempting to imagine the factious controversy which may have raged within the Chapter over this decision, and that it continued until those who loved the lancets forced the dramatic change in plan which left the western end of the building permanently disfigured.

The remnants from the demolition, and the slope on the paving, suggest that they demolished something that looked like **b**. The vaulted entrance F was the undamaged narthex which survived the fire. The presence of this narthex in 1200 would have forced the builders to lower the paving to give headroom at the entry to the nave, and I think this is the reason the paving of the central area was laid to a slope. It was the easiest and quickest solution. They may in 1194 have intended to pull this vault out, but meantime the narthex formed an entry into the crypt, protecting pilgrims from the building work overhead as they passed into the temporary chapels down below - VI:62. So the vault was reprieved for the time being, and when the temporary roof was built over the nave the temporary paving had to be dropped to pass under the temporary vaults of the narthex.

Temporary things have a tendency to become permanent: it is still with us today. If the vault had been removed the pier footings suggest that the paving would have been laid in three levels, with the stairs where shown in **c**.

3. Branner, 1969, p.82.

4. See GEOM:XIX-D.

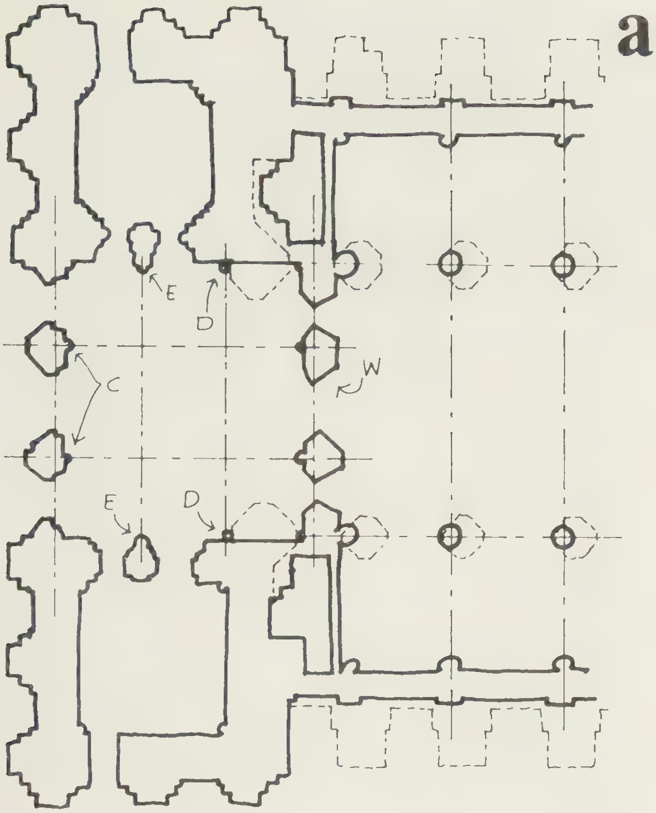
5. Conant, 1944; Fitchen, 1955; Grodecki, 1958, p.98-9; Delaporte, 1959, p.304; and Villette 1967 who quoted the then Master of the Works, Jean Maunoury. Conditions at Chartres are not extreme. The maximum wind speed is 25 meters per second which is the same as Amiens, Beauvais and Paris. It comes from the WSW which is the least dangerous direction, for it is almost the axis of the nave.

6. Mark, 1972, p.97-8. The model he used is incorrect in a number of particulars, not least in the thickness of the triforium wall and in the total omission of the cross walls which buttress them.

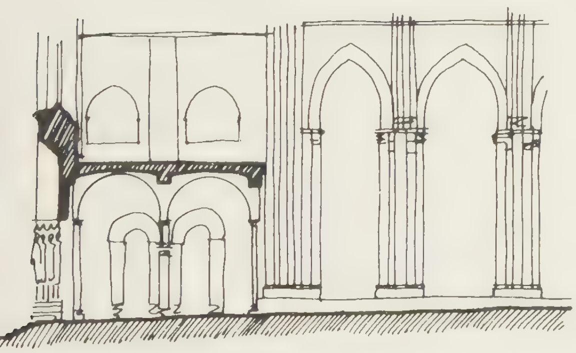
7. Mortet, 1900, p.314. See translation Branner, 1969, p.103.

8. Grodecki, 1958, p.98-9.

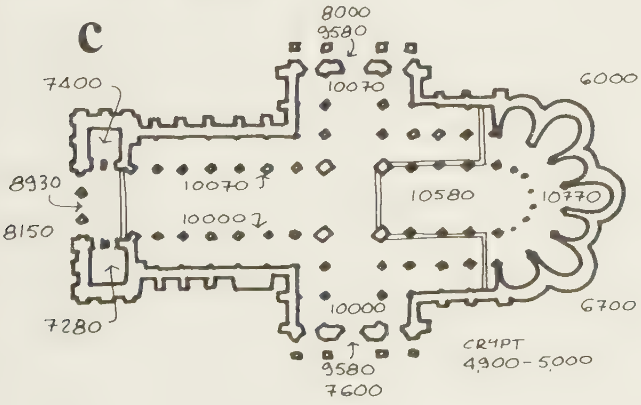
a



b



c



wheatfields roundabout. The roof anchors the building to the ground by its simplicity, which is in some way heightened by not being encased in half a dozen spires and pinnacles. Its directness is its greatest asset. Along with most of the other great cathedrals of France, Chartres opted for a single, high-pitched roof with a minimum of embellishments to give the simplest form against the skyline.

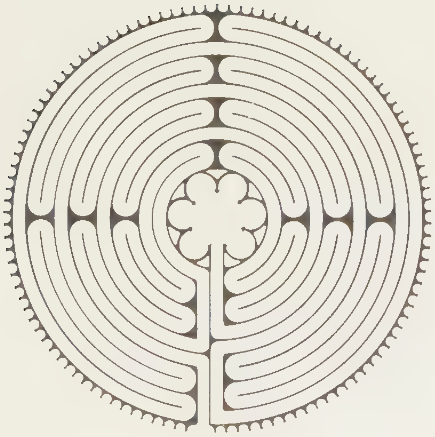
However, this had not always been their intention. The cathedral was originally to have been capped with a bevy of towers, perhaps like Laon or Linden-unter-Lahn. "Had they been completed, these towers would have had an extraordinary effect on the skyline, like a many-pronged crown resting on top of the city. More than any other element, they would have emphasised the half-open, half-closed aspect of the Gothic exterior, which was accidented by many different shapes and which was constantly moving as the sun altered the position of the shadows."[3] But gradually, during the 1220's, this electric silhouette was toned down. First to be left off was the central tower, then those in the east, and lastly the flanking spires of the transepts.

A central tower presupposes a flattened roof, so that the tower would appear to project as forcibly as possible above the ridge. The raising of the roof pitch marked the final, though not necessarily the only point at which it was decided to eleminate the tower.[4] Can we discover when this decision was made?

It now seems to be agreed that the upper row of flyers may have had something to do with it. Structurally they do not take any of the thrusts from the vault, for they are set too high in the wall. They meet the vaults level with the top of the cells immediately underneath the cornice of the roof. During the war Conant suggested that they were built to withstand the force of the wind against the steep roof, and once this conclusion had been stated it was so appealing that scholars have had to repeat the proof many times.[5] The most recent study by Robert Mark[6] using polarised light on plastic models shows that the upper flyers are in fact too light to withstand the wind load on their own, though they do take some of the load off the thick clerestory walls. However, this is a result of modern structural analysis, and it seems clear that the builders of the time believed they were essential.

At one time historians thought that they had been added to the building around 1316, from a document describing the visit to the cathedral of three eminent masters from Paris in that year.[7] However a modern translation of the text will not bear out to so heavy an interpretation. As has happened before, a theory has been developed from the documents without it ever being referred back to the building. In 1958 Louis Grodecki convincingly showed that the upper flyers of the choir were, without any doubt, erected with the cornice.[8] He examined the stonework itself and saw that the coping over the flyers was carved into the stones of the roof cornice. Though many of the choir copings were replaced in 1880, there is an unpublished letter written by Canon Brou while the repairs were going on which says the same

PHOTO 472: The labyrinth is the largest single decorative item in the building. Dating from 1200, it was designed by the first master Scarlet during his second stint at Chartres. Contemporary texts say nothing which might explain its purpose or meaning. Yet there are still dozens to be found in churches of the period, and many use the same layout as this one. There used to be a brass plaque in the middle displaying the Minataur, Theseus and Ariadne who was holding a ball of string. Was Theseus the Pilgrim and Ariadne the Virgin Herself whose string guided the seeker home after he slew the beast? Then what of the beast? If he was the devil within us then the message is a remarkably modern one - for without guidance we risk madness in any internal struggle with the beast. And in those Platonic times guidance was considered to lie in the knowledge whose patron was the Virgin, which may be why she held the string. Is this why some labyrinths were called 'The Way to Jerusalem'? Then why were other called 'Daedali'? and were inscribed with the names of the masters of the works? Was it because only the master was able to build the Heavenly Jerusalem here on earth, the cathedral, or because their skills exemplified the Way, for in creating these consecrated works was not every act itself a devotion?



Geometry XIX-A

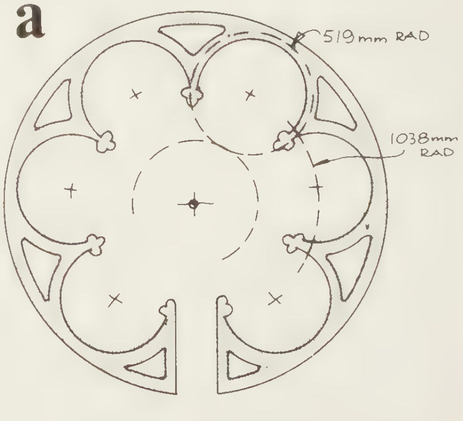
The plan for the labyrinth, Scarlet-G, 1200

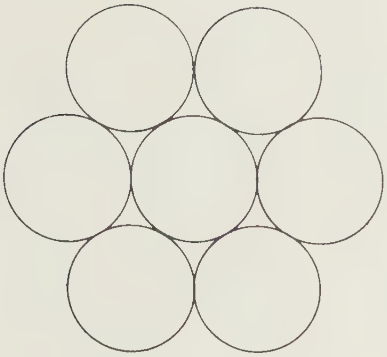
The meanings that seem to have been given to the labyrinth are deeply bedded into the Gnostic tradition of the Chartres School, and are amazingly rich and powerful. The geometry is no less rich. Before reading this follow the path round the labyrinth, note how you walk around the left inner rings first, and then the right, and how afterwards you do the left outside rings, and then the right. Notice how symmetrical the pattern is, and how orderly. Each part has a meaning, and each segment stands for a position on the Way. Just as the cathedral is man's access to the altar and the Eucharist, so the labyrinth is an ideogram of the path man must travel in himself to be worthy of what the cathedral itself stands for. I discuss this in James, 1977.

If you ever get the opportunity to walk around the labyrinth you will travel a path of 261.55 meters. This is exactly 740^{PM}, and as the labyrinth has four quarters, each quarter plus one spells MARIA EST ASSUMPTA. It is also 20 times 37, which is the prime number Scarlet used in the geometry of the western rose - see James, 1973 (2), and n.24.

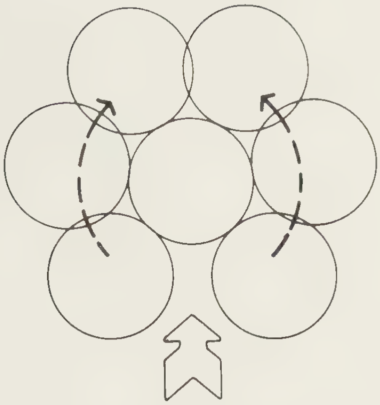
The cogs around the outside of the labyrinth have puzzled many people. Are they the ring of fire which surrounds Paradise? There are 112 of them, plus two halves at the entry. The circumference of the circle taken through the centres of all the cogs measures 114^{PM}, or one per cog (with an error of 2mm per cog, see later). The eighth century Arab alchemist Jabir ibn Hayyan divided the four elementary qualities (earth, air, fire and water) into four degrees with seven subdivisions giving a total of 112 classifications which between them explained all materials, liquids and gasses found in manifest creation.

112 is also the number of years the moon takes to repeat the Metonic cylce six times, and this is the cycle which determines the date for Easter. The entry being to the left of centre there are 55 cogs on one side and 57 on the other spelling ECCLESIA and DOMINE,





b



while the whole including the two halves which add to one spell both CHRISTUS and MARIA MATER DEI. The labyrinth has 31 curved tracks and 4 straight ones (31 = 3 + 1 = 4), and 35 spells BVM. There are 28 half-round changes of direction and six quarters - 28 is the number of ANNA the mother of Mary, while both 6 and 28 are the first two Perfect Numbers. Together they add up to 34 which is one off BVM, and one off MV, or Maria Virgo. Half of 34 is seventeen which is the letter R standing for the Resurrection.

Twice 35 is 70, which spells JESUS,
Thrice is 105, which is TRINITAS, and
Four times is 140, or CHRISTOS EST.

Now let us move on to geometry, and look at the six-petalled form in the centre **a**. Draw six circles around a circle of the same diameter **b**, and then ease them over so that they overlap one another by a fifth of the PM. As there are five overlaps, the total movement has been one PM. This leaves a gap at the entry precisely the width of each of the eleven rings surrounding the centre. So the perfect Rose of God has been opened by the width of the Way to allow the pilgrim to enter Paradise.

To determine the size of the petals, Scarlet made the figure in **b** of circles which were each one third of the circle enclosing them in **c**, and this circle was made a quarter of the diameter of the whole labyrinth. Divide the Way through this world by the number of substance, and divide the goal itself by the number of the spirit.

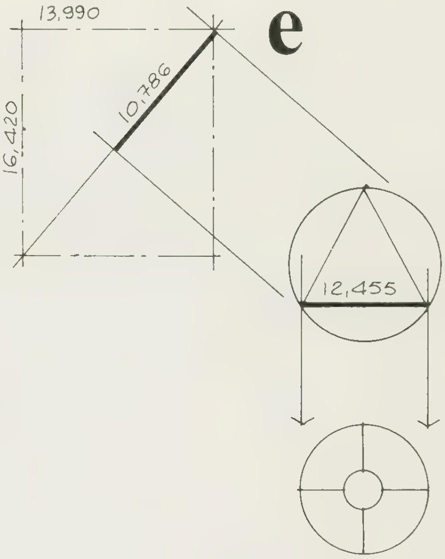
The first step in the design was therefore to determine the overall diameter D in **d**. However there are four circles around the perimeter, and we should deal with the others first. The circle A is invisible for it passes through the centres of the cogs. It measures 36^{PM}, the number of the BVM plus one, the number of the Apostolic twelve times the Trinity, the number of the Virgin times the earthly quarternity.

Each cog in the circle measures ¾ of the PM, so that the diameter of A is 48 of these units, while the outermost circle B measures 49 of them. 48 spells INRI while 49, as the important seven sevens, spells IXS.

The apparent real perimeter C cuts through the 114 small circles and makes their cog-like shape. Its diameter is one tenth of the overall internal length of the cathedral from the western doors to the eastern chapel (actual length 129,100mm, while C is 12,885mm. Remember in VIII:73 this is the length of the year at $365\frac{1}{4}^{PM}$, so the labyrinth is a cyclic part of the whole of time). Just as the cathedral is a model of the Heavenly Jerusalem, so the labyrinth as a microcosm of the cathedral is the symbol of the role the church plays in guiding men along their journey.

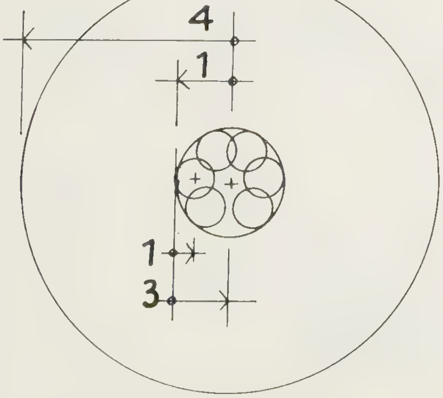
The last circle D from which the construction in **c** was derived, was itself derived from the crossing. Scarlet in **e** took half the diagonal of the crossing as it had actually been built, not as he had planned it six years before, and on it drew a circle. The diagonal in medieval geometry represents the union of the sides, and as we suspect from ch.VIII that these may have been intended to represent both Christ and Mary, the diagonal is a repetition of the statements in the west portal, of Christ enthroned on His Mother's lap. The circle is then the perfection of this union, and within that he drew the triangle of the Trinity, the Godhead within the whole, whose side produced the circle D.

e

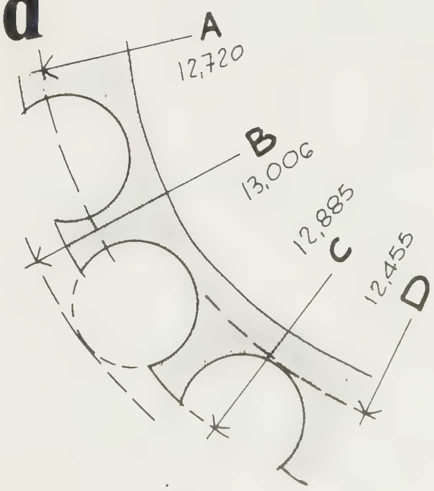


The ring between D and the petals was then divided into eleven tracks in **f**, and the width of each of these was divided into eleven parts, two of which made the solid strip between the tracks. The proportions of the tracks reinforce the numbers which created them. Eleven is a somewhat non-Christian number. Its source may be Arab, and this is discussed in James, 1977.
...VIII/XVI-A/*...

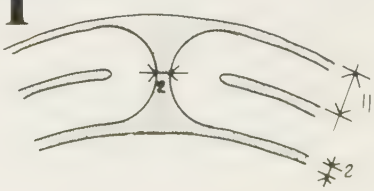
c



d



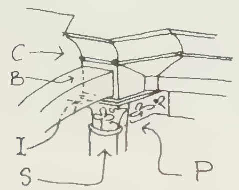
f



9. Quoted by Delaporte, 1959, p.304, n.1. Many of the blocks are quite unmistakably original.

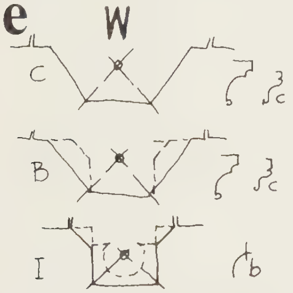
10. *The top courses under the roof.*
The shaft in front of the wall buttress between the clerestory roses finishes in a capital, and from there its projection has to be resolved in a cornice. The sketch shows one arrangement where the impost I lies over the capital P and its shaft S. It starts a movement which is continued in the block B to transform the round shaft into a much larger trapezoid. The cornice C above that amplifies the projection and completes a serpentine path around the roof. In the various drawings the courses are indicated by the same letters, and where the stone itself changes plan or there is a discrepancy between the lower stone and the upper, the lower part is shown dotted.

d



In the choir they used an extra impost placed between B and C to raise the cornice above the roses. In the south transept they used an extra block, and in the north the capital is set higher up.

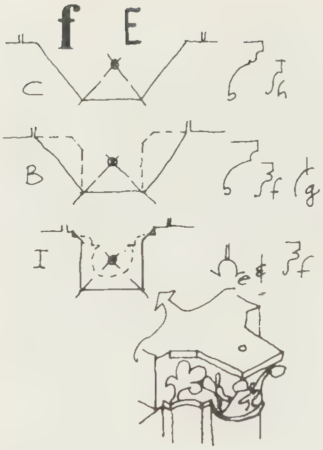
e



Nave: Shown in **e** the capitals in WS.VI and WN.V are probably by Jade-b. The others and B and C are by Bronze-*Swan, Groovey, Lobelia,* and *Pruner*. The exceptions are a few stones in WS.I and possibly WN.I by Rose-*Cup* - XVIII:53. Underneath some of the caps the small projection on either side of the shaft has been enlarged with a small corbel, often worn and sometimes replaced. In two cases it looks like Jade-b.

Choir: In **f** the caps are Rose-*Goose* in the ES.I and possibly EN.I. The rest of the caps and most of the blocks are Bronze-*Bustle, Gash* and *Spring,* except for a few in the east by Jade-g in 1226. The cornice seems to be completely Ruby-*Hide, Eyes, Circus* and *Frills*. Where the bridge from the ES tower meets the cornice part of the stones of the latter project over the arch under the bridge, showing that the arch was in place with or before Bronze-f who built the blocks. This is elevated in XX:40. Notice now how each master has his own technique for finishing the section behind his leaves, and how they are quite consistent with the ones used in the triforium in XII:6.

f



South transept: In **g** the caps are by Green-l, and were placed over the wrong shafts by Ruby next year, as the shape of the pilasters behind the shafts show. They were laid with the drip moulds over the adjoining roses with their rosettes - XX:34. The impost, two blocks, and the cornice were all laid with the next part of the drip mould which has no rosettes by Olive-n, and includes some of the twisted leaves by *Spirex* and *Lapwing*.

North transept: In **h** the caps are by Scarlet-p and Bronze-q. I am uncertain about the others, particularly as one side is quite unique. However we should remember that we are approaching 1240, and the simplicity of the generation which produced the major part of the building is now a thing of the past. The suggested attributions are made on the drawing.

In plan the cornices can be subdivided like this in **i**, with the usual uncertainties in the north transept. The ones over the transept facades come from the analysis in the next chapter, where the masters still seem to be working consistently, though a long time has elapsed between the triforium cornices and here, and so the value of this criterion is reduced.

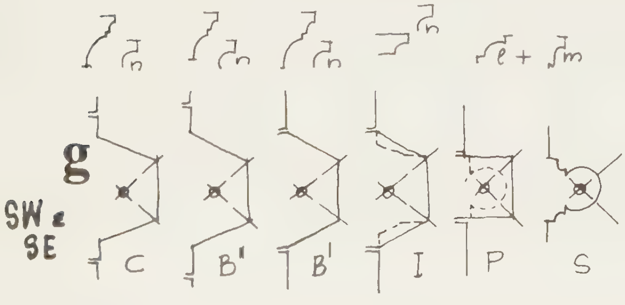
In the nave the cornice on the southern side is 34,960mm from the footing under the piers. In the north there is a double layer of paving stones over the cornice, and the lower layers seems to be almost at the same level as the southern one. Both by Bronze. In the choir the southern side is higher than the north, 45,040mm and 44,940mm. Both are Ruby, and both have been placed straight on top of the arch over the rose, and as the bays in the south are a little wider than those in the north (stemming from the fanning axes in Scarlet's first plan that were never fully straightened by later masters - VIII:31) so the rose is slightly larger, and thus finishes higher. The fan has altered the tilt in levels.

The cornice in the south transept is the same height as the choir, even though the bays are wider - the lancets were set lower so the larger rose would not rise too high. The north is the opposite, for there the cornice on the eastern side is 300mm higher than the choir - for the opposite reason.

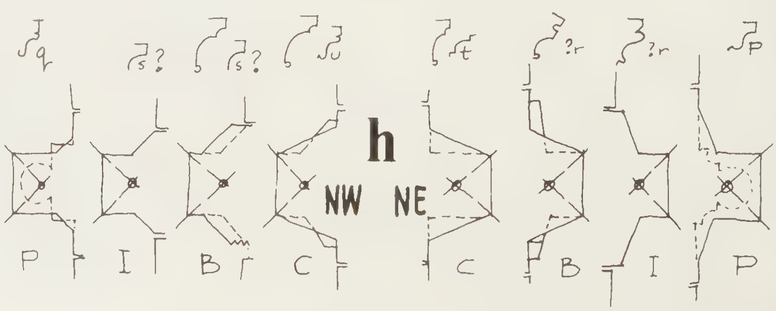
However, the western cornice in the north is higher than the east, as is the northern side of the nave, which is 210mm higher than the south. From VII:24 I would have expected this to be closer to 90mm. The difference will help us to understand that they fixed their vertical dimensions by measuring from some part underneath, not from the ground floor. In this case they measured from the top of the triforium walkway around the outside of the building, for Jade had raised its level on the northern side to RL.25,500 compared to RL.25,310 on the south. Bronze therefore measured the same 19,630mm vertically on each side, perpetuating the excess height begun by Jade.

The seating for the nineteenth century cast iron roof is two courses above the cornice, but this may not have been the case in 1222. In a number of early medieval buildings the original roof was placed almost on the cornice, with the cross beams set close to the top of the boss, not 1.3 meters above it as now. The cells of the vault could not have been laid until the roof was on, as there was no way to get the rainwater out of the depression over the springing between the cells. But the evidence shows that parts of the nave cornice and all of the choir was laid after the ribs and bosses, and so after the roof. This shows that the roof beams were set up before the cornice was laid, particularly in the choir. A similar approach can be seen in the choir triforium, where the cornice was left until much of the interior stonework had been finished, presumably to keep them from injury, and both cornices were by the same master - Ruby, XII:6. This zone was studied with the help of Oliver Probin and Dee Mitting.

g



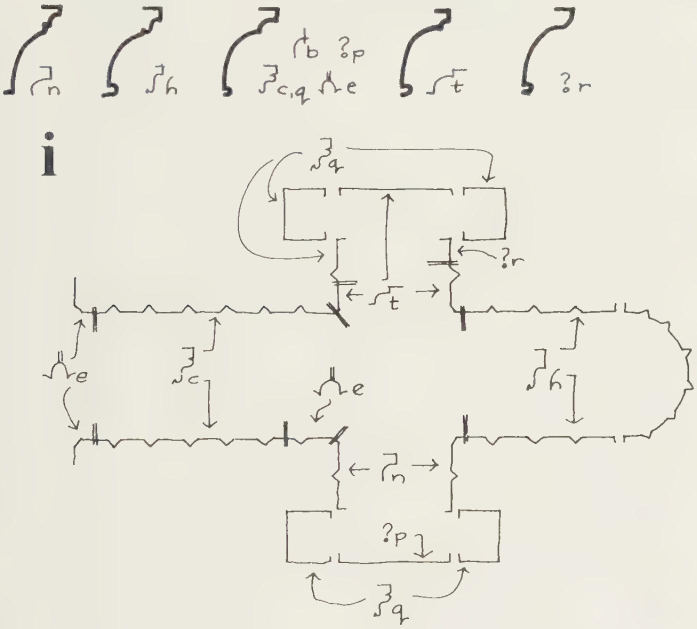
h



thing - a valuable confirmation that the replaced work we see today does not appear to differ greatly from the original.[9]

A close analysis of the upper flyers in the nave will show that they were also built with the cornice just as in the choir. The uppermost course of the flyer, the coping course, often obscures the leaves and crockets of the cornice. But underneath the cornice there is a large block which projects over the pilaster between the windows. It has splayed sides which are decorated with leaves but its outer face supporting the flyer arch is plain, and this shows that the block was designed to receive the arch, even though the cornice was not.[10] These blocks were not replaced in the nineteenth century, nor have they been cut back.[11] Since they were designed for the flyers their date gives us a final date for the third tier, which is 1222.

Is it possible that they were intended from the beginning? Certainly in the nave they are far too thin compared to the weighty buttresses and arches in the tiers underneath them, while in the choir the extra height they add onto the already slender supports makes the whole arrangement extremely spare.[12] From the inside of the SW tower we can see the answer on top of the adjoining buttress: where the coping over the middle transept flyer meets the buttress there is a small swelling out of which projects a rusty piece of iron. The top of the swelling is broken, but was once meant to support a crocket. It was to have been fixed over the iron spike, but must have been knocked off when the heavy cornice under the upper flyer was placed over it.[13] The decision to build the third


i

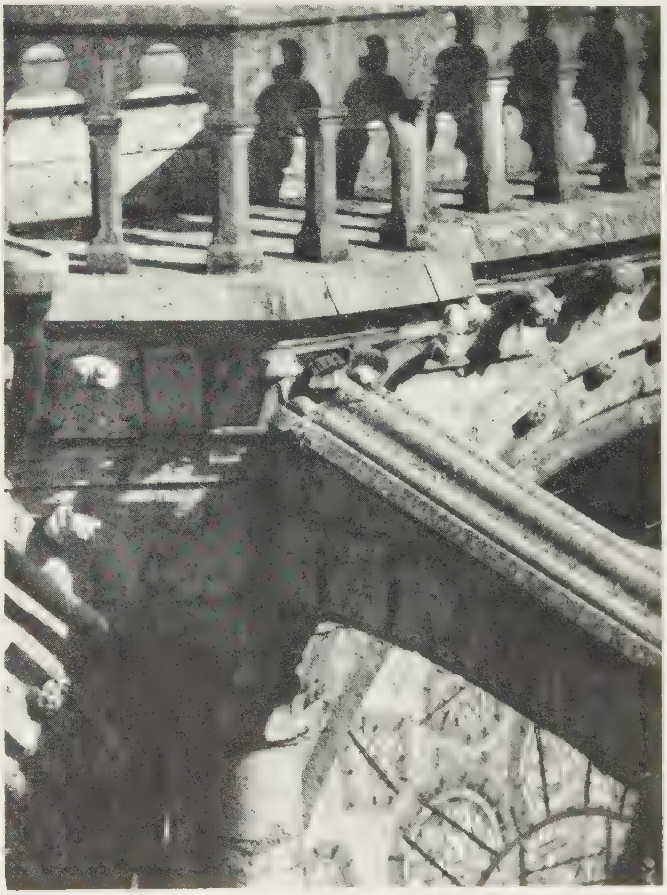


PHOTO 475: The block under the walkway over the choir was cut to support the third flyer arch, as no leaves were carved on its outer bearing face. In the next course the uppermost section of coping has been carved with the cornice.

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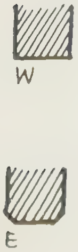
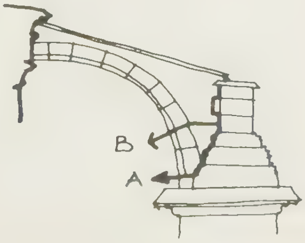
[11] Not all the stones are unambiguous, but note particularly the pitting, wear and surface on WS.I and WN.I. Also see records of repairs in the Archives.

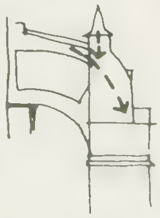
12.

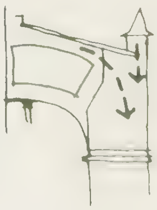




[12] All these arches are square in section in the nave, and arrised in the choir. All transepts are also arrised except for the bottom course on the west. The joint A where the arris starts is shown in the SW.I arch looking south. The second joint B is indicated where the voussoire has been thickened.

[13] As a number of scholars have remarked, it is significant that in Chartres the nave buttress was reduced on the outer side, for it shows that they did not yet appreciate that the thrust from the flyers bears down on the inner side of the buttress, and therefore tends to open up the outer face. In later buildings the pinnacle which 'holds down' the flyers was placed on the outer edge, not on the inner. Mark and Prentke, 1968. The Chartres buttress and the typical later solution are shown in the sketch.





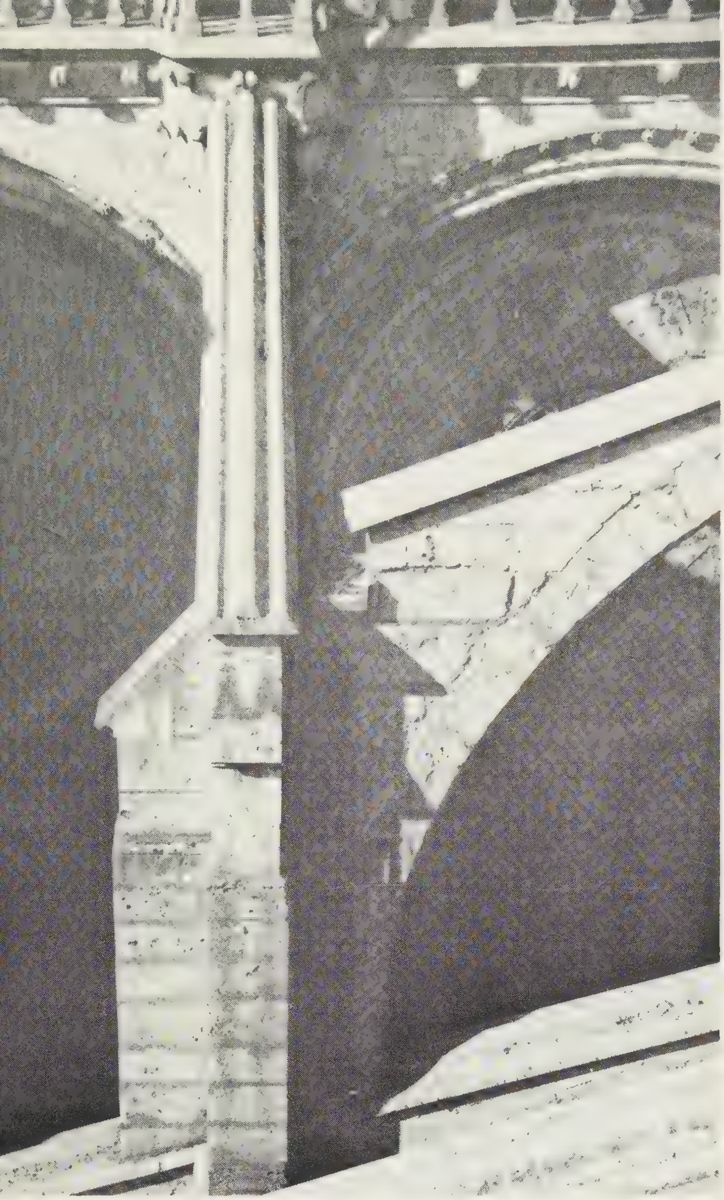


PHOTO 476: The double channels of the coping over the SE.I flyer, adjoining the choir. Notice how it intersects the flyer from the choir on the right.

tier was therefore made after this coping and before the nave roof cornice. In drawing the isometrics I concluded that the decision could only have been made during the time of Bronze-c.[14]

Do not lightly accept this decision to build the third row or arches. It was an enormously expensive and time-consuming job involving a great deal of centering and hoisting which would have had to be justified to the client. Would the arches have been put in without good reason? It could not have been justified by the strength of the wind itself, for this had been a constant factor from the beginning. It would have had to be to solve a new problem not considered before, which would therefore be a change in the design. Since its purpose was to stabilise the roof, the change would be in the roof itself, and logically this would suit the decision to raise it from a low pitch to a high one, which was itself a part of the decision to eliminate the crossing tower. This crocket is the only firm evidence in the building that can be used to date the decision on the tower, taken apparently in 1222, the year the roof timbers were erected.

Bronze designed this roof, for it could not be started until he had completed the cornice underneath it, and it had to be substantially in place before Olive could lay the bosses in the next campaign. No doubt the timbers for it would have been collected beforehand, perhaps even years before, and transported all 60km from the forest of Belême. It was no mean task to haul 16 meter oak beams weighing three tonnes or more over twisted dirt roads from so far away, and then the mammoth effort required to raise them into position 35 meters above the paving.

But a roof represents more than merely the covering to keep out the rain. It is the capping for the building, and from outside forms the most bulky part of it. Its ridge determines the silhouette, and hence the upper plane of the mass of the cathedral. Bronze's solution was quite brilliant, and illustrates an important aspect of nearly all the geometries devised for the upper parts of the building.

You will have noticed how in one sense the vertical geometries are much simpler than may have been expected, being nearly always derived in a fairly straightforward way from measurements taken from one

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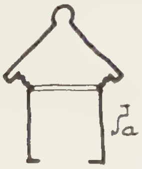
14. In the choir the coping over the middle row of flyers meets the central support, and the edge is carried across its sides to be continued in the outer leg of the arch. This can be see in above photo, where it is bent up before it meets the other arch. This and the upstand above it preparing for the next stage in the support suggests that the third row of flyers was intended at this point. However, there is one exception in ES.II where the coping does not turn up, but continues into the next arch, and the pier over sits on the inclined face of the coping. For this reason I think that the change in the roof was contemporary with this point in the choir and therefore came either from the client when the tower was eliminated, or from Bronze's realisation some time after he had altered the roof that it would need further buttressing.

j



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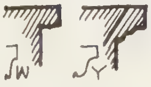

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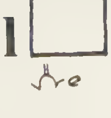

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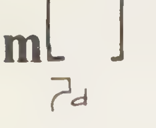
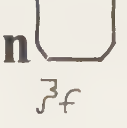


n



The copings over the middle nave flyer **j** were begun by Cobalt-Z, where he follows the same arrangement he used in the two gables fronting the buttresses, of a roll mould along the ridge - XVIII:49. Though the lower roofs were not begun by Cobalt, he put in the ridge course with his pinnacles - XII:38/V. Notice how the edge of the lower buttress roof projects with a square outline, while the upper one has a small moulding under it **k**. The first was begun with the top of the ostium by Ruby-W, and the upper by Scarlet-Y - XVIII:49.

The crockets were placed on both gables at the same time as the outside scaffolding was being removed by Cobalt-Z, and the heads at the top of the coping was inserted as the last of the inner band of scaffolding was removed by part of the plan or other. There are few complex figures, or difficult harmonics. On the other hand it is far richer and many-levelled than any of us suspected. There is no one set of ratios for the whole, but many. Some will affect structure, others the external horizontal mouldings, and yet others the internal voids. In origin they will usually be derived from the same things, the main axes, walls and piers of the plan, but only the mathematics differ.

We have seen how in all the best geometries the various systems stem from a few base dimensions and how, after much by-play, they are brought back to their beginning. This principle of circularity in which the ends are tied back into one another, and are seldom left unattached to basic parameters, flows through nearly all medieval geometry. It seems to have two purposes, to assert the primacy of the basic dimensions and of the whole over the parts, and to verify the geometric method itself. For how could the master know that the arrangement he had made was true, and the best? Just to play with ratios is not enough, for that lacks discipline and intent. But to introduce variety, and to allow contradictory sets into the design, and to then show that they all amount to the same thing in the end by bringing them back to their base, is immensely exhilarating.

I put it this way because my own experience in designing with geometry shows that when an arrangement gells like this, the sense of achievement is almost overpowering. It is not an easy thing to do. You labour over your drawing board, trying different ratios, thinking into its meaning and refining the details, all these manipulations and ideas surging through your mind at the one time, until in a supreme moment the different strands lock into one another. It is the moment of knowing. The process is validated by being brought back on itself.

We should therefore expect to find in the roof the 'proof' for the rest of the cathedral. And indeed we do. It is a masterpiece of integrative design. The initial ratio used between the main axes running through the bay and the span was 3:7. Begun by Scarlet-A it was continued unchanged by his successor Bronze, and here, 26 years later, he has used this same ratio in the roof, showing that he at least had not forgotten the first step. The height of the ridge from the floor of the crypt is three times the span, and of course, also seven times the bay. Thus both the 3 and the 7 in the plan axes are recreated in the section.

There is much more than this, as you can read in GEOM:XIX-D. But behind this simple decision lies the profoundly important criterion that every part of the building should reflect the basic principles written into the plan. Circularity implies the concept of total unification. Nowhere is it stated so clearly as in the roof.

Fitchen has shown that medieval masons probably roofed the building before erecting the high vaults.[15] There may be exceptions, but on the whole I believe he is right. Without the roof the rainwater would have collected between the vault and the outside walls, and they would have had to drain it away, or risk the mortar being washed out.

Richard King found evidence for such drainage over the crossing vaults at Laon, and Norbert Borngatz found the same over the aisle vaults at Beauvais. There are none in Chartres.

In the aisles the vaults were filled over with mortar and rubble to the top of the boss. This formed a solid platform under the triforium which would have easily shed the rain to the side. But in the high vaults the cells were only lightly parged to keep the weight down, and there are no signs of drainage holes through the vault or through the wall. The dispersal of rainwater was such an important factor that after the fire of 1836 terra-cotta pipes were pushed through the cells of the vaults to get rid of it. If the snow and rain had been allowed to collect in the hollow between one cell and the next the moisture would have percolated through the joints and leached out the weak mortar. No builder could have permitted this, particularly as the entire stability of the vaults depended on the solidity of this section. I am therefore certain that the roof was built before the vaults.[16]

Fitchen goes on to say that the roof beams "provided the support for a temporary staging or platform of planks from which the whole superstructure of the roof was erected without additional or independent scaffolding. There is evidence that powerful lifting devices were

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Bronze-c - XII:38/V and XI:24.

The copings over the upper nave flyers are simple in **l**, by either Olive-d or Rose-e. The way it covers the leaves of the roof cornice suggest that Bronze had not intended to take his coping so high. In the choir the lower coping **m** was begun quite early, as can be seen where the extension of the middle arch from SE.I meets the central support under ES.II. The coping meets the support halfway up and is built in, and is therefore the work of either Bronze-c or Olive-d. The upper coping **n** which is previewed in the stubs projecting from the roof cornice by Ruby-h was begun at the outer extremities of the buttresses somewhat earlier, by Bronze-f or Jade-g. Sorting these out I would prefer to donate the nave upper copings to Rose, the lower ones in the choir to Olive and the upper ones to Bronze. See discussion in XXII. The middle nave coping **m** should be Ruby-a from XVIII:49.

[15] Fitchen, 1961, p.26-.

[16] From calculations found in Fitchen, 1955, p.18- and Masse, 1900, p.21 the weight of the medieval roof would have been somewhat more than a thousand tonnes. If only one of the cranes was used, and if it did nothing but raise the rimbers and lead for the roof, it would have taken only 100 days to lift all the roofing material, and much less for the nave alone. Hoisting would not have been a major limitation - XIII:33. However, imagine the problems of transporting 1000 tonnes of lead by boat from Brittany and the 18 meter long timbers from the forest 60km. away. See map VI:4.

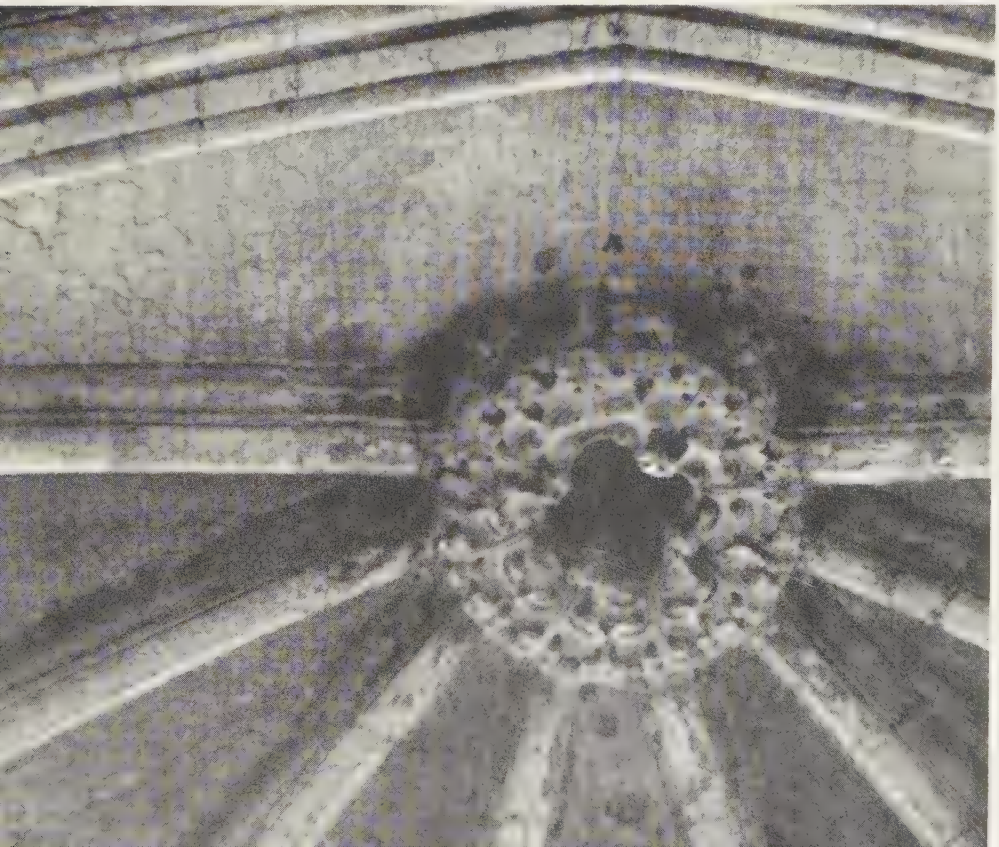
The light construction in the Chartres cells is sharply contrasted with the massive filling in the aisles. The latter use the constructional methods employed in the earliest high rib vaults over the Durham transepts, where an enormous amount of filling has been set over the cells to stabilise them. The lighter construction, along with the openness of the clerestory wall and the transfer of loads to the outside all point in the same direction: that the master's conception of the role of the uppermost storey was opposite to that of the aisles in the lowest. See later discussion.

sometimes installed within the roof structure, sustained on the tie-beam supported platform, by which heavy loads such as large keystones could be lifted and set in place.''[17]

These keystones are enormous, over 1,200mm across and cut from blocks a meter thick. They must weigh two tonnes or more each. There is no way they could have been lifted into place from the sides and trundled horizontally into position. The demands on equipment, men and scaffolding would have been too great. The simplest solution would have been to wheel the boss down the floor of the church until it was underneath its destination and, after breaking a hole through the temporary roof, simply hoist it directly into its place.

All the nave bosses were carved together, for their templets follow the same pattern. The ones in the choir form another group, for they all have four-foil openings. The first pair on either side of the crossing form another group. From their dimensions and from the gangs who carved the leaves around them I have discerned the work of Olive in 1223 through to Ruby in 1227.[18] The nave was built first, naturally, followed by the crossing and then the choir. With the building of those in the first bays of the transepts they completed a logical and structually sound capping to the cathedral, with cells and flyers mutually supporting one another, and helping to brace the inner space of the crossing. Only the outermost cells of the two transept arches were insecure, for the transverse arch is too thin to absorb any side thrust from

PHOTO 478: The rondpont boss by Bronze in 1225 with the figure of Christ and two angels.



Geometry XIX-B

The upper clerestory walls and vaults

The arc cut into the walling under the roses, just over the lancets, determined where the centre of the rose was to be, even though the capitals marking that centre were installed later. In the nave Scarlet adjusted the heights so that all these centres would be in line, even making the rose in the narrower first bay elliptical to overcome the problem in the earlier lancets which had been placed too low for him. In **h** the height to the centre of the nave roses is 29,990mm, which is just three times the bay by $\sqrt{2}$. The bay forms a 5:1 rectangle to the intended overall vault height discussed at the end of GEOM:XVIII-E of 120^{PM}, and within this lies the *ad quadratum* of the rose. Half of the Rose height positions the triforium passage P (+15mm). This scheme was not realised as Ruby lowered the top of the wall and Bronze lowered the vault.

The underside of the nave cells rests on the larger outer arch over the rose. Placed by Ruby, though this height was implied within 200mm by Scarlet's stones under the rose, (as long as Scarlet was not at that time working to his higher vaults). The total height of the nave wall is 33,130mm, which equals the width of the nave measured to the glass in the aisle windows. As Ruby had located that glass plane he could have located this wall height too.

The plate tracery of the rose has a diameter of 4,600mm, equal to the gap between the arcade piers; the frame has a diameter of 5,500mm and the outer arch measures 5,980mm, which was the module discussed in GEOM:XVIII-B, and was implied in the space left between the ribs of Scarlet's *tas-de-charge*.

In the choir the height to the centre of the roses is 29,710mm (+50 for settlement? to 29,760mm) being ten times this same module. It is also the space between the inside faces of the perimeter buttresses. Thus we could draw the dashed square in **i** through the centre of the rose and within the buttresses. Alternatively he may have begun with 1½ times the distance S-S for one side of a triangle, and the clerestory walkway height for the other, in which case the hypoteneuse would give the rose, and this is shown on the right.

This centre is also located almost 4/5 the height of Ruby's caps in the choir, and is the crypt module above Bronze's extrados, shown on the left (23,780 + 5,940 = 29,720mm. 24,670 + 5,100 = 29,770mm). The centre is also 2φ times the arcade caps, just as the latter was φ times the space across the aisles. Lastly the height from the crypt to the centre of the rose equals the height from the floor to the underside of the vault cell.

The top of the eastern clerestory wall is 32,850mm above the floor, and though the actual arch is the work of Bronze, its height was to a great degree implicit in many earlier decisions. It is twice the span, and thus represents in the elevation of a double bay the

[17] Fitchen, 1961, p.23.

[18] See right side next page.

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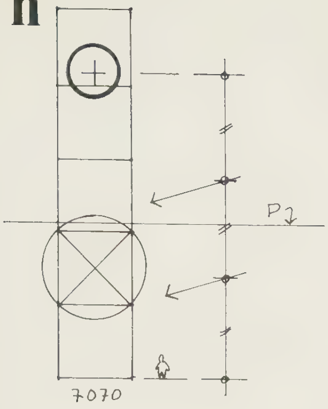

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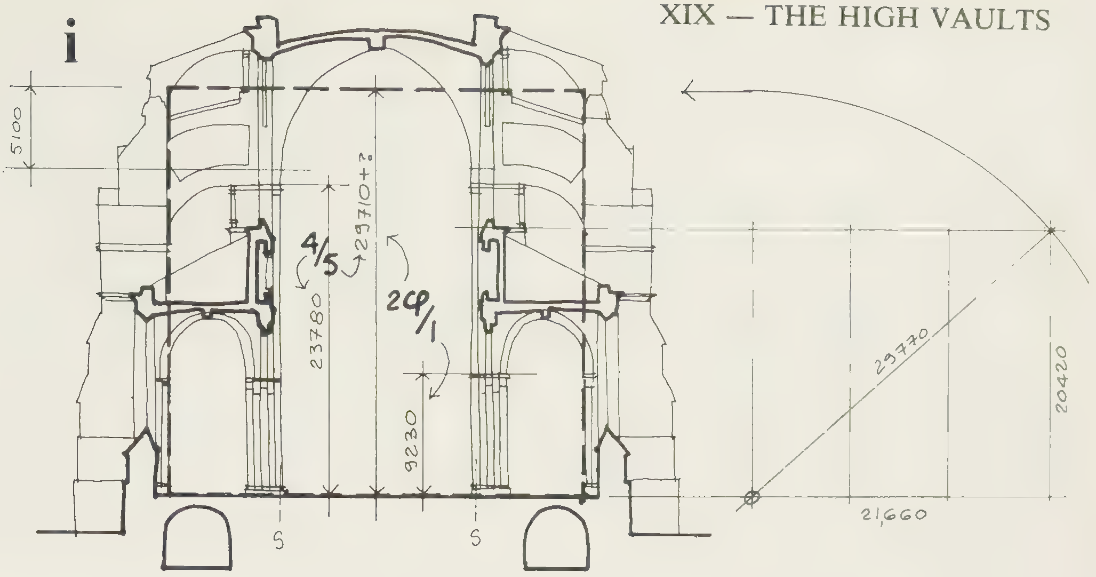


same 7:3 ratio used in the pier axes. See how this concept for re-using the original proportions in the uppermost parts of the building was also used with great finesse in the roof in GEOM:XIX-D.

Notice how nothing in the elevation below the rose relates directly to the axial measurements of the plan. There is nothing in the arcade, the triforium or the clerestory sill to correspond to the span, the bay or its roots. The axes produce the dimensions which frame the top and bottom of the elevation, but within that frame everything else was articulated by other ratios, and though these latter were usually derived in some way from the first, there are no direct connections.

As this is true for the whole building, this policy must have been widely held and deliberate. The result is to form a series of overlapping harmonies which produce complexities and subleties not possible otherwise. One aspect of this policy was not to leave any loose ends between one proportion and the next. This could not always be done, for one man's intentions could be cancelled out by the next, but where there is a lot of work by one master, as with Ruby in the triforium, or Bronze in the vaults, we can see that one of the rules of this game was to ensure that there were no loose or unconnected ends. That is, if Scarlet's height of five bays was subdivided by the clerestory walkway into two parts, then that height would relate to the first in some way (in this example 35,350= √3x20,400mm), and also the residue would be related to something used elsewhere (35,350-20,400= 14,950mm, which is half the height of the rose at 29,900mm).

When first working out a design I imagine that the master would have begun the elevation with the most important delineators, like the overalls, the axes, and the major zones. All these would have been represented on the drawing with single lines, as we find in the Reims Palimpsests, Branner, 1958. Then he would have given it bulk with the vertical structure of piers and shafts which would have left a number of rectangles between the piers, zones, axes and so on. Being experienced in solving this sort of problem, for he was born into it, he would have subjected each of these sections to a searching analysis to see how they could be related to what had gone before. This is the process I call circularity. Whether a master was always able to interpret the works in his own way, or whether his methods had to be modified on each job, cannot be discovered from one building on its own. When we examine more of them and compare a master's work in many places we may find the answer to that question.

To some extent it was inevitable that these secondary proportions would not coincide with the first. For example, if the pier drum was derived from one fifth of the bay as in GEOM:VII-A, then this module would always reflect the bay, and so would the space between one drum and the next. But by transforming the square fifth into a circle of equal area, through the ratio of 9:8, Scarlet ensured that the space would never relate in a simple way to the axes. Bronze resolved this problem by modifying the piers so that the spaces formed their own system using φ, and later applied these dimensions vertically to the aisle capitals and vaults, and here in this Geometry to the high vaults as well.

Because the measurements to the high vaults can be taken from three planes (the underside and topside of the ribs, and the top of the cell) to two levels (the floors of the cathedral and crypt) it was possible for the proportions in the vault to be used to tie many loose ends together. In Romanesque buildings like the chapel of St. John in the White Tower the barrel vault has just one curved plane and no articulation, and so the geometry is much simpler.

We could say that the necessities of the building in which many different elements were needed to construct each part, a number of ratios would be produced that were distinct and overlapping, and which they felt had to be related in some way to the whole. In this contradiction between their desire for unity and the complexity of reality lay the stimulation for much of the growing richness in medieval architecture.

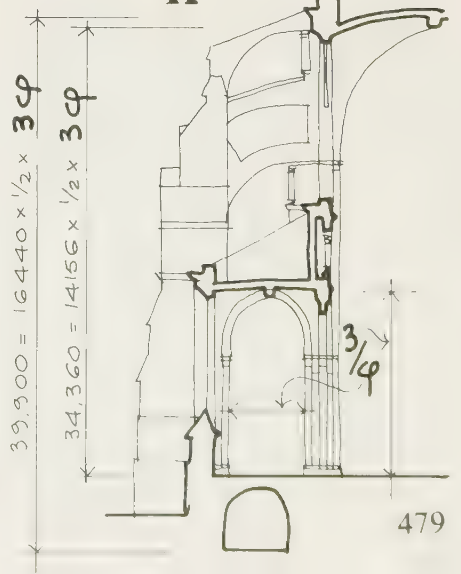
The elevation of the vaults seems to have been entirely the work of Bronze, and he worked into it a summary of many of the building's fundamentals, as long as we can increment today's measurements by the sag and settlement discussed in n.18 and GEOM:XVIII-A.

The most 'Bronzian' ratios reflect the system he had used earlier in the aisles, GEOM:XI-A. There he had started with the spaces between the peirs which related as φ:2, and had extended one space three times into the vault, thus utilising the ratio of 3:φ. The aisle was evolved in terms of spaces.

In the high vaults he based his dimensions on the axes which, like the spaces, are implicit rather than explicit. Neither exist in their own right, being merely disclosed by the masses. As in his other geometry he loves dimensionless untouchables like axes, corners, spaces and points.

The span and the double-bay were both reduced by φ:2, just as the spaces in the aisles had been related by the same ratio. Three times these lengths produced the height to the underside of the rib to the floor, and to the underside of the cell to the crypt **k**. Thus the

k



space under the high vault reflects the axes through 3:Cρ, while the spaces under the aisle vault reflects the void of the aisle in the same proportion.

For an example of circularity, notice in **l** that the height to the top of the cell is equal to the crypt plus the height of the rose (34,970 = 5,100 + 29,870mm), and that half the latter is the measurement to the triforium passage P from the floor (at 14,985mm) and 1/Cρ times the height of the arcade caps (at 9,250mm).

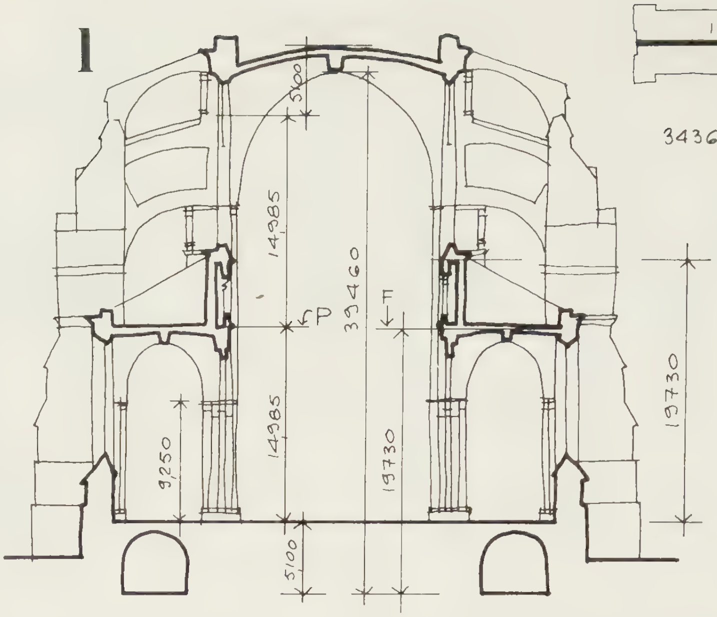
The underside of the rib to the crypt is double the height from the crypt to the footings F under Ruby's triforium cross walls in the nave, while this half distance equals the height from the floor to the second string in the nave. The underside of the rib to the floor is one quarter of the overall length of the cathedral from the west portal to the point of the diamond around Bronze's chapel IV. Everything gets locked in somewhere.

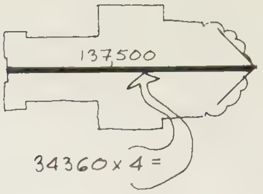
The height from the crypt to the top of the vault cell, being the plane under the roof and the actual stone enclosure of the cathedral, is 10/11ths the overall width of the nave (40,080:44,040mm) and forms a 5:2 rectangle with Bronze's H axes. Here in **m** is the pattern of these 5:2 rectangles in the vaults, including the shaded ones to Y, the clear width between the piers, and to Z the aisles (+15mm), while R is the level of the triforium passage (−20mm). The importance of this 5:2 ratio can be seen if we refer back to GEOM:XI-C/**j**, with its horizontally placed rectangles. Also notice the other 5:2 which was used in the north towers in GEOM:XX-A.

The logic here is impeccable: use the same proportions across the walls for the height of the cells as had been used across the H axes for the height over the top of the ribs at the boss. It also located the top of the cornice showing how it forms a sort of plane over the cathedral.

Lastly in **n** there are two squares through the SS axes. They can both be extended by √2 to determine the triforium zone. Above the first square lies the footings for the triforium cross walls F in the choir, also by Bronze XII:14, showing the clear relationship that was seen to exist between that wall and the projected heights for the vault. These footings are not at the same level as the paving for the triforium passage P which relates to other factors discussed in XII:25-33. The height from the footings to the next square then equals the TT square from GEOM:XVIII-B. It is shown dotted, and positioned the clerestory walkway and the epicentres of the exterior clerestory wall piers. The top of the upper square positioned the underside of the cell of the high vault. The implications of this important figure are discussed in the text.

l





Another √2 reduced the vault to Bronze's extrados in the choir. The circularity process with connections to other systems seems to have been taken through the crypt height, marked C on the drawing.

Notice that nothing relates to the springing, showing either that Rose's thinking in the next geometry was alien to Bronze, and/or that this capital was, as far as the vault was concerned, unimportant.

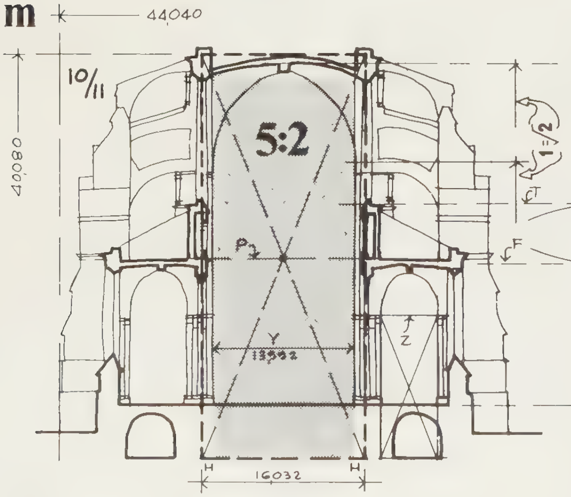
The vault ratios have been taken to the axes, and to the boxes forming the base planes of the triforium and clerestory structure, not to the decorative string courses or the passage. The last geometry in **n** shows clearly how the zones of the cathedral were conceived by Bronze as tripartite, define by the SS shafts one way, and in the other by firstly the solid block of the aisles, vaults and the filling over them, and secondly by the semi-solidity of the triforium defined by the diagonals from the first, and thirdly by the repetition of the first square placed upon the second. Thus the triforium is an intermediate zone, dependent through the diagonals on the squares, and containing the bracing for the clerestory walkway which supports the upper walls.

It was an incredible achievement at this height above the ground, to have been able to relate the great distances of the building so accurately to one another. It is in the vaults, which are in a way the purpose for the structure underneath, that the main axes and the H axes, along with the bay and the span, are reconciled. The roof cornice and the top of the vault pull together the major delineators. It is a beautiful summation.

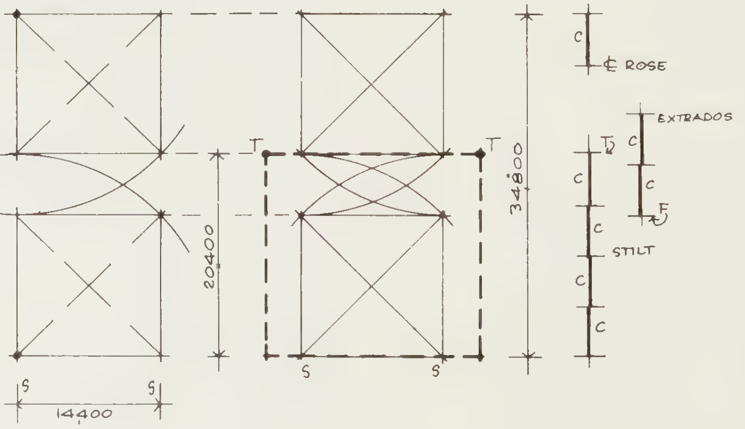
Horizontally the picture is not as clear as this, as Bronze had little to do with any of the perimeter epicentres, and I therefore have few indications of his intentions. Maybe we shall get some from other buildings.

...XI-A/XII:25-31/XVIII,A,B,E, F/*/ XIX-C

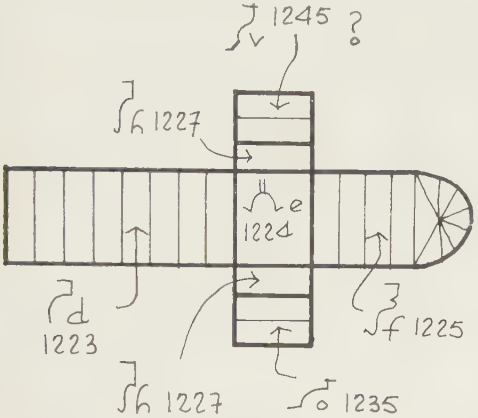
m



n



18. *The vaults and bosses.*



The bosses of the choir are clearly by Bronze. *Brancher* did bay I, *Bustle* is characteristically III, *Groovey* in IV and *Bustle* again in the rondpont. This boss has a figure of the Blessing Christ with angels on either side. It is very like the figure in the NE.III aisle boss and by the same crew: sleeve, hands, arrangement of beard and the face - XV:43. This will fit his campaign 'f' in 1225. The internal diameter of their holes measures 616mm and they are then all reduced to a 4-foil opening. The diamater is the Teuton cubit times √3: √2, and the 4-foil is characteristic of Bronze's dossier.

The great central boss seems to be the work of Rose-*Cup,* and if so was cut by him in 1224. The geometry is more certainly his - GEOM:XIX-C. The holes through the centres of the bosses were an important constructional device "for through them ropes could be let from above the vault to shift and lower the falsework below" Fitchen, 1961, p.126. But the hole in the central boss is enormous, about a meter and a half, and would I think have another more sacred purpose. This may be followed in Coomaraswami's Collected Essays, particularly in "The Symbolism of Archery" and "The Significance of the Dome". He is saying that there must be an opening in the top of the building to allow the soul to fly to God, and for the Spirit to descend into the sacred enclosure, and that it acts as the 'bull's eye' or 'mark' of the Way.

The vaulting of the crossing before the choir suggests that its roof was built before the choir's, and therefore that the walls buttressing the crossing arches were carried up above the eastern clerestory walls so that the crossing could be finished as soon as possible. Chartres, in spite of the many innovations present in its design, is a structurally conservative building - witness the mass fill over the aisle vaults, the solid triforium cross walls, the triple row of flyers, the thickness of the clerestory walls, and so on. The early completion of the crossing is in the same tradition, for once finished it would have provided at the centre of the building a secure structure against which the more fragile arms could be stabilised. Also, the decision to omit the crossing tower was not made until 1222, and so these parts may have been hurried up in anticipation of getting the tower above the roofs before they were erected.

The bosses on either side of the transept were carved together. They both have the same internal diameter of 470mm, or the English cubit. S.I may be *Frills* of Ruby's team, and is formed by two leaves paired, joined at the centre. Their date would be 1227. They would have been built under a temporary lean-too roof as the walling over the next pier would not have been taken up to cornice level - XVIII:76/x. As the transverse arch rose above the top of the stones the roof may have looked the way I have drawn it in XVIII:76, and the last isometrics. See Ruby's wooden ties in n.19.

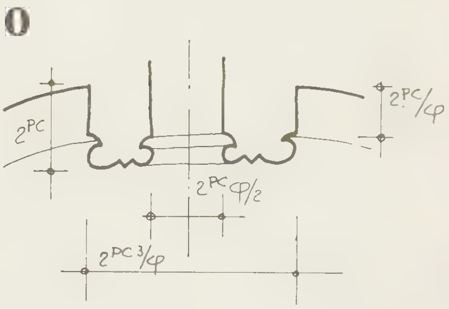
The two others in the south were built together. They are smaller than Ruby's with simple overlapping leaves gathered in the centre with the curvacious silhouette of Green's north tower corbels - XX:37/e. Their holes measure 430-50mm which is 2:√3 his foot. If carved in campaign 'o' the roof would not have been ready for them, so campaign 't' in 1241 is much more likely. The main reasons for this attribution come from the isometrics.

The two end bays in the north have holes measuring 500mm, and of all the possible campaigns I prefer 'v' in 1243. Uncertain.

This leaves the nave which I find somewhat difficult to place, even though all nine bosses were carved together. Their holes all have the same diameter of 528mm. From the relative timing of the others the roof would have been erected with the cornice over the walls supporting it. The logical sequence would be cornice and timbers to the roof, then begin the ribs and bosses, followed by the other roofs timbers and its covering, followed by the cells. The timberwork helps support the scaffolding and the cranes. The erection of both at the same time would help to maintain the stability of the clerestory walls. The final work on the roof would advance with the bay by bay construction of the cells.

From this timing I would expect the bosses to have been done by Bronze, Jade or Olive, though there are a few connections with Ruby which would have dated them before the cornice, for the arrangement of leaves is not unlike some of his in the sanctuary. However, as Bronze-c finished the cornice the roof would have been built by him, allowing Olive to finish the vaults in the next campaign.

So, of all the possibilities I prefer Olive in 1223, for the leaves have his attenuated and emphatic edges and sharpness. I and II could be by many masters, III fits *Lapwing,* IV *Squelch* and *Banana,* as with VII and IX. VI is *Spirex* and VIII a lobed *Lapwing.* Olive's authorship is reinforced by the geometry of the opening which is his CF with φ, in **o**.



However, some uncertainty must remain in this part, for I was not able to examine any of them at close quarters at this stage of my study.

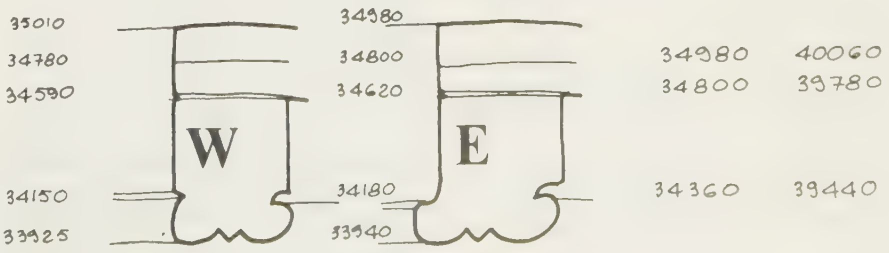
The heights of the vaults were measured directly through the openings in the boss, from the top of the nineteenth century render and filling to the existing floor. The RLs of the render were determined from within the roof space, and of the floor from within the cathedral, and all sets were reconciled.

The medieval cells consist of two layers of tuffau totalling 150-200mm thick, and over this 200-250mm of fill and render were added after the fire of 1836. I therefore calculated the final heights from the top of the pier footings to the upper surface of the tuffau, and these are given on the left. The nave and the choir were the same to within 30mm, though the actual RLs of the four vault cells on either side of the crossing were closer than that.

Externally the roof cornice of the nave is at an average height of 34,960mm from the footings, and of the choir the average of both sides is 34,990mm. I assumed that the former, which had been laid by Bronze, was meant to coincide with the top of the cells, and that over the centuries the vault had sagged in the middle by 180mm in the choir and 210 in the nave. these adjusted heights are given on the right, one column to the footings, and the other to the crypt floor. See GEOM:XVIII-A.

I have tried to relate the present heights to different geometries, but even with a computer program, without success. The only appealing results came when I assumed these sags, and adjusted the figures upwards. This is the only excuse I have for the assumption that the top of the cell should be in line with the top of the cornice.

From these figures and the geometry they imply discussed in GEOM:XIX-B, and the earlier discussion on the design of the bosses, I conclude that the formwork for the western vaults was the work of Bronze-c in 1222, and that he also did the formwork, and the bosses for the choir in 1225.



them, and there was nothing built to the outside of them to prevent the arch from being thrown outwards. So two wooden ties were attached to the top of the transverse arch to hold it to the large arches round the crossing which were quite strong enough to stabilise the work. You can still see them today exposed through the stonework of the cells.[19]

Whereas the ribs of the vaults are carved from the hard durable limestone of Berchere, the cells are made from a lighter material. It is a pumice-like stone called *tuffau* which may have come from the valley of the Loire or from near Vernon on the Seine.[20] This shows that the heavier stone was intended to carry the loads and to transfer them to the waiting buttresses, while the *tuffau* represents the loads, and was therefore made as light as possible. The cells are slightly concave when seen from below, which gives them an arching action to spread the load to the ribs.[21] These cells were seen as infills, which could be twisted and warped to suit the appearance and geometry of the surrounding elements.[22] No longer are the entire vaults set out to their own geometry, as in groin vaults, but have become like canvas stretched between the independent geometries of the arches and ribs.[23]

We know that when completed they tended to act together, for once the mortar had set the whole vault became bonded into one, and the real distinction between support and suported tended to disappear.[24] After the bombardment of Soisson during the 1914-18 war many of the ribs fell in, though the cells remained standing.[25] Opposite cases may be quoted just as easily, without having any bearing on the master's original intentions. The way they thought about the possible actions within the vaults may not, and in all probability is not the same as the way the stone finally acts. It was their view of the structure which determined the methods they used, and from this came their geometry. For historian the 'real' structure is unimportant compared with the 'conceptual' structure.

Focillon wisely argued that "if the rib was primarily formal, and intended simply to extend the pier design into the vaults, why then was it adopted and propogated so widely by precisely those architects who were antagonistic to decorative effects and most insistent on the preservation of mural values even in the piers themselves - the Cistercians? Thus the concept of the rib as a support, which is vindicated by the study of the earliest buildings in which it was used, retains its significance in the Gothic system itself."[26]

The ribs were most useful during construction, for they helped the builder form the complex curvature of his shells *in situ* without having to work them out beforehand. Perhaps the real origin of the rib lies in its use as an erectional device to simplify and cheapen the construction. We have many modern examples of materials, and even entire architectural motifs being evolved and adopted because they were easier to handle. Precast concrete panels, walling and beams are a good example, for they were first devised to save the trouble of constructing formwork on site. The wall panel can be made on the ground under optimum controls, and then only had to be hoisted up and bolted into place. Out of this simple idea has grown an entirely new industry. Panels will sometimes include the windows, framed and glazed, the doors, electrical wiring and even the wallpaper. The fact that it is poured into moulds has tempted architects to treat it like a sculpture so that now we have a totally new style of building which has been made possible by a technical innovation. It is quite unlike the glass-box style of the early years of the modern movement, but has produced a three-dimensional complexity foreign to the simplicity of twenty years ago.

Similarly the problems of forming groins in the Romanesque vaults may have stimulated the masters to find a simpler solution, like a cover-mould which would disguise their difficulties. Once somebody, apparently in England, thought of setting the vault out from the groin rather than from the curves of the vault's surface, the rib was inevitable. It was much easier to construct a good-looking vault by working outwards from pre-made ribs than by working inwards to the fortuitous intersection of two independant barrels.[27] But as with precast wall panels, the new constructional tool soon imposed its own discipline on the masters, and in time became a way of architecture, and even of decoration, in its own right.

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[19] Grodecki, 1958, p.97, n.7 suggests they were put in after the 1316 expertise - n.6. But as they are built into the cells of the vault the stonework would have been disturbed if they had been inserted, and there is no evidence for this. If put in later it would have been easier to put them on top. Van der Meulen, 1965, p.106 gives the correct interpretation. Notice that once more, as in the nave aisles and the western crossing arch, it is Ruby who used wooden ties.

[20] Shown on map in VI:4.

[21] The cells bow up in the centre of each span an average of 150mm.

[22] Kubler, 1944 summarises the arguments well. Heyman, 1968, p.183 writes "thus the rib, besides having a structural purpose as reinforcement for potentially weak 'creases' at the groins, also enables the vaulting compartments to be laid out more easily, enables a good deal of form-work to be dispensed with, and covers ill-matching joints at the groins. As a bonus the rib has been thought to be aesthetically satisfying, and all of these functions might be thought of as the 'function' of the rib". See ch. XI.

[23] The often unharmonious junctions formed between intersecting vaults in a groin vault system show that the individual geometries of each vault were more important than the shape of the intersection. The rib-and-infill system altered all that. Gervase described the same technique being used in Canterbury a generation earlier - Willis, 1869, p.49.

[24] Fitchen, 1961, p.66- on cambers and the action of a vault as a shell of double curvature. More important is Alexander, Mark and Abel's 1978 analysis which follows an earlier investigation of Cologne, in Mark, Abel and O'Neill, 1973. They have shown experimentally that the webbing of these rib vaults "clearly act as a three-dimensional structure and that its standard treatment in the art-historical literature, as a series of almost parallel arches, can be quite misleading ... The entire webbing, even at the scale of Gothic construction, can be structurally self-supporting ... In this light the *constructional* and the *aesthetic* aspects of the rib take on greater importance than the *structural* function" (p.251). See VIII:47.

[25] Brunet, 1928.

[26] Focillon, 1963, i, p. 8. However, the evidence from the first ribs in the Durham aisles shows that the ribs were not put up first and the cells later, but they were built course by course with the rest of the vault - in fact as a groin vault, these ribs were thus not seen as structural, but as decorative cover moulds.

[27] See discussion in Frankl, 1962.

[28] GEOM:III-D, X-C, and XIII-B.

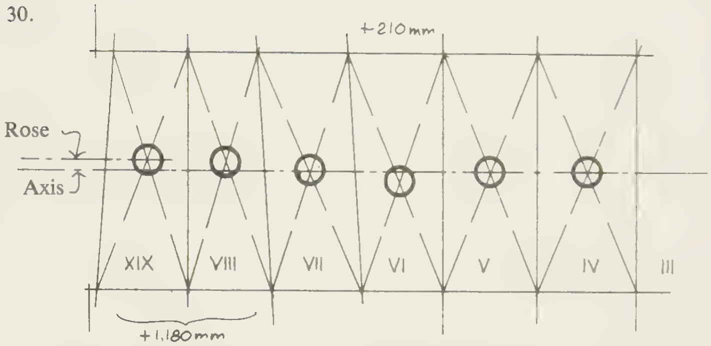
[29] XVIII:47 and GEOM:XVIII-E.

Some masters collected all the loads and forces from the vault, and brought them together into one which was assumed to pass through the axis of the bay. But others seem to have separated them to deal with each independently as I have shown in some of the geometric examples earlier in the book.[28] But in either case the arrangement of the thrust-resisting structures came from the ribs along which the forces were seen to act, rather than from the space they covered.

In the aisles all the ribs were set out over circular centering, though there were a few distortions needed here and there to bring unequal bays up to the same level. But in the high vaults the ribs are all pointed. The lower stones in the *tas-de-charge* do not always line up with the slope of the ribs higher up, showing that the centering for the independent ribs was built after the *tas,* and to a different radius.[29]

The ribs were always set out with stringlines stretched between the wall shafts. Consequently any deformation in the shape of the bay was reflected in the plan of the vaults and in the location of its boss. This is clearly illustrated in the western bays between the towers which are 1,180mm wider on the southern side compared to the north. Draw the straight lines of the diagonal ribs between the shafts of these two trapezoid bays, and see how they intersect away from the centre.[30] Stand in the nave and sight along one of the cables which hang through the boss to support the lights, and you will see that the two western bosses are eccentrically placed to the north, and that the centre of the western rose lines up with these two bosses. As far as this can be measured with blumb-bob and eye the actual offset of 420mm is very close to the theoretical.

30.



The seventh bay, the first one beyond the towers, has equally spaced piers, and though it is not square the boss is on the centre line. But in the sixth bay the piers are 210mm further part on the north side, and its boss is predictably displaced towards the south, just as the bosses of the western two bays, being larger on the south, are displaced to the north. This is why the western rose was not placed in the middle of its facade. Since in medieval structural theory the stability of any structure depends on the accuracy and relevance of the geometry, the building will follow it, no matter how strange it may look. The most important structural - which means geometric - considerations from inside the building forced the outside out of symmetry.[31] The same thing has happened many times before, for the inner truth is more important than the outside appearance.[32]

The vaults seem to represent more than just the ceiling to the cathedral, as we can infer from their geometry. Two things stand out. Firstly, as with the roof discussed earlier, the vault summarises major elements in other parts of the building. The second geometric interlude in this chapter shows how Bronze used the same ratios in the high vaults as he had in the aisles, but instead of being

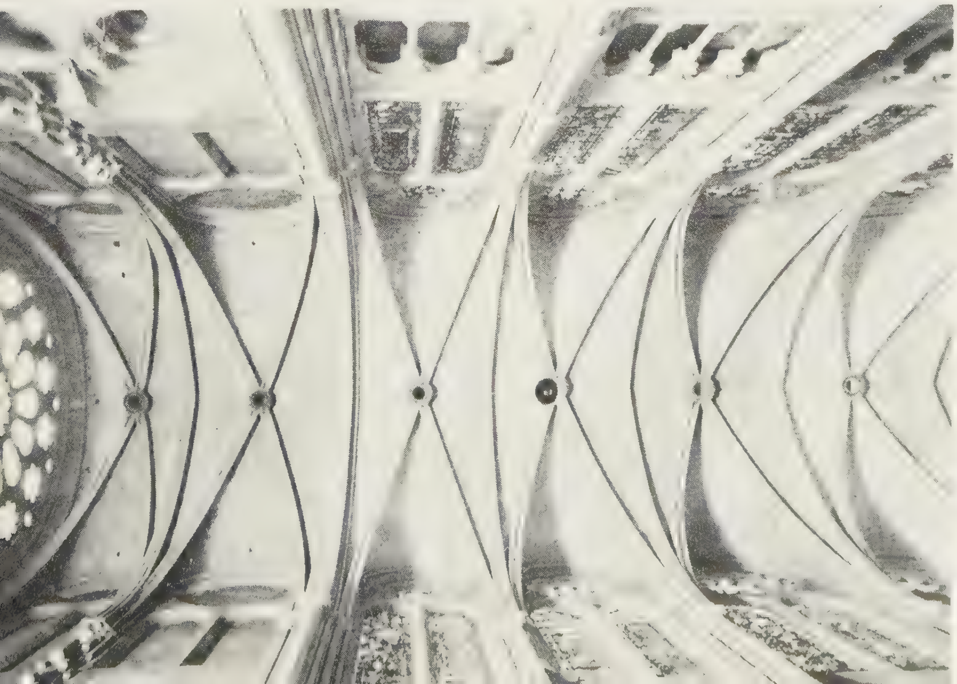


PHOTO 483: The vaults of the western nave drawn in n.30.

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[31] Other comments on the size and location of the rose are found in Frankl, 1957, Grodecki, 1958, p.100- and Critchlow, Carrol and Lee, 1973. Frankl and Grodecki tend to cancel one another out. See also van der Meulen, 1965, p.89 and 117 who believes that because it forced up the end cells it is too large, and was therefore meant for another place; equally some masters may have intended to install a smaller rose over the old lancets, which would have been the more normal scheme for that time. They were forestalled by one who believed that the giant rose should fill the entire width of the nave.

[32] For an example, see the buttresses over the south porch - GEOM:III-D.

based on the spaces between the arcade piers, they start from the major axes. Thus for him the vault enclosed a space rather than capping a mass. So it is the voids themselves which generate the aisle vaults, and the axial origin of those voids which must determine the high vault. Though the ratios used in both vaults are the same, the different bases used reflect the significance attached to each zone.

To understand this examine the bottom drawing on page 480. The clerestory zone forms a square between the shaft axes one way, and the other from the top of the cell to the walkway outside the windows. There is a matching square underneath this one which rises from the floor to the triforium, where it locates the underside of the footings supporting the walls which lie between the piers and the perimeter buttresses.

In the nave this lower zone is the most massive in the cathedral. The buttresses are huge, the wall is punctured by a single window per bay, and from the outside looks as solid as a cliff. By contrast the upper half looks weightless from outside, the wall being concealed behind a screen of arches and buttresses, while the extent of the glass reduces what stone can be seen to a collection of shafts and corners. Outside, this zone stretches from the perimeter triforium walkway to the top of the flyers, and as we approach the clerestory wall this zone rises up the triforium roof until it is located between the clerestory walkway and the main roof itself.

Internally the two zones are separated by the triforium, reflecting the aisle roof outside. The lower zone is still all mass, with heavy piers in front of the darkness of the aisles, and above the obvious solidity of the vaults. In complete contrast in the upper clerestory zone the wall has been almost completely eliminated, and in its place are bundles of very thin shafts and large areas of glass. The triforium is a sort of twilight zone, hollow and light like the clerestory, but encased within horizontal bands of masonry like the aisles.

The geometry exactly corresponds to this trichotomy. The upper and lower zones are represented by squares set between the main shafts of the piers, while the space in between comes from the diagonals of either square. The middle is strictly derivative and dependent. The flanking squares are primary, and the positions they define are very important for our understanding of Bronze's concept.

By being located between the shaft centres, rather than any of the axes or wall faces, Bronze has denied the real supports of the building, being the massive stonework of the piers and their drums centred over the axes, in favour of the apparent supports - those thin shafts that rise to the vaults. A thick pier taken up to the same height does not appear to rise, for the eye does not move up and down in the same way. In Tournus we read the unarticulated cylinders as solid units, and understand at once that the loads from the roof are being taken by them, and that they are quite adequate to do so.

But at Chartres the drums only reach the aisle vaults, their great size is clearly supporting these massive sections, easily yet securely. But once we rise above the capitals there is no more structure, at least not in the sense found in the piers. The wall is broken into two horizontal bands by the triforium passage, and the only signs of vertical support lie in the bundles of filament-like shafts at each bay. We know that they are too small to carry loads, yet we agree in one part of our minds to accept that they do do the job, because there is nothing else visible from inside to do so. If they don't, what does? So, by a sleight of hand, our eyes have been deceived. We have been diverted from structure as mass to structure as forces passing along these filaments. Being weightless, we can see the forces within the building rising as easily as falling. Where at Tournus we could only appreciate the functional direction of the building as downwards, at Chartres we can take it either way. This is entirely the effect of divorcing the thin shafts from any other support structure.

One inescapable consequence of this is that the building as weight and inertia fades from view, and above the aisles it is increasingly seen as a collection of forces and thrusts. A piece of stone has a weight, and we may pick it up, and appreciate its solidity in our hands. But a force has no such weight. Thrusts are real enough, but you cannot pick it up and take it with you. It is an attribute rather than a property. It comes from the arrangement, and not from the material itself, from the nature of the cathedral rather than from the quarry. Mass has thus been replaced by function.

By centering the geometry on the filament Bronze has emphasised the forces within the building at the expense of the mass. These forces are deliberately continued upwards into the vaults, making a mockery of the real loads involved in spanning such great distances in stone. It is a pretty pretence for the audience while the real work is being seen to behind the proscenium.

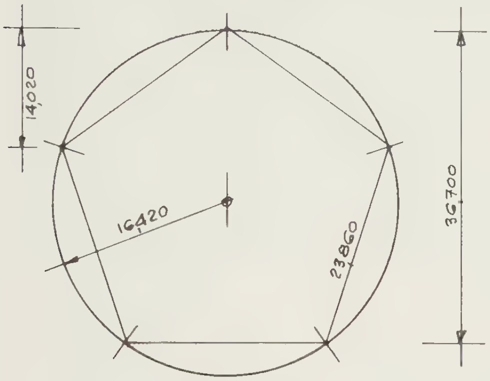
In this context reconsider the nature of the tripartite subdivision of the elevation. The lower square defines the zone of solid structure, of the material universe where heavy materials may be touched, and can be known for what they are. The upper square defines the zone of weightless glass-filled fillamented architecture, a pavilion of incredible delicacy which is suspended rather than supported over the aisles. As the aisles are earth-bound, so the clerestory is hanging from heaven, with its glorious light suffusing everything, its irridescent walls palpitating with the radiant glory of Paradise.

In between lies the triforium zone. By being dependent on the two extreme squares it shows its intermediate role, not independent, but forming a necessary separation between the powers and realities above and below it. However, no visible part of the triforium, neither the string courses nor the arcade nor any part of the passage relate to these square or their diagonals. They derive from a quite different and secondary sequence as discussed in chapter XII. The squares located those parts of the structure that are hidden from the viewer. No one inside the cathedral can see backstage to where these two planes define the three zones. At each plane the plan

Geometry XIX-C

The vault over the crossing, Rose-e, 1224

From the sequence of work either Rose or Olive could have installed the crossing vault. It is taller than the other vaults, and larger, and the hole through the boss is the biggest. There is a bevy of high-powered lights set into this hole, so I could not measure the thickness of its cells, but assuming it was not too different to the others, the dimensions to the underside of the ribs relate to Rose's springing through a gigantic pentagon. In the same pentagon the height of the 'gable' is almost that of the longitudinal dimension of the crossing. As discussed in GEOM:VIII-A the crossing footings show that Rose in 1196 first drew this figure for the centre of the cathedral. Olive in the next year modified the plinths to suit his own geometry, slightly increasing the span Rose had been using. Rose used this larger span in calculating the springing and boss heights, which is where the small discrepancy comes from between the earlier and later dimensions. However, each time Rose would have had to set this figure out full size in a field outside the town, and would have constructed it by drawing a circle whose radius is the span as in GEOM:XVIII-F.



Does the use of this figure in the one place, beginning in 1196 and finishing 28 years later, show that Rose was using solid geometry? He could have been using the dodecahedron or the icosahedron, regular solids from which all these dimensions could have been found. It could be objected that no one at that time could have known the nature of the solids, yet 1500 years before they had been described by Plato, and we all know the place Plato held in the school of Chartres. In the last years of the middle ages Fra Luca Pacioli wrote a treatise on the Golden Mean ("De Divina Proportione") in which Leonardo da Vinci drew convincing sketches of each one. No one would say that Leonardo had discovered the solids, for he just helped to publicise what had until then been known but kept private. See Kollar, 1975. Nevertheless my personal view is that solid geometry was not used by the individual masters. Except where there is no sign of it in any of the elevational studies, and was too difficult to use in practice.

...VII-A/XVIII-E/XIX-A/*...

Geometry XIX-D

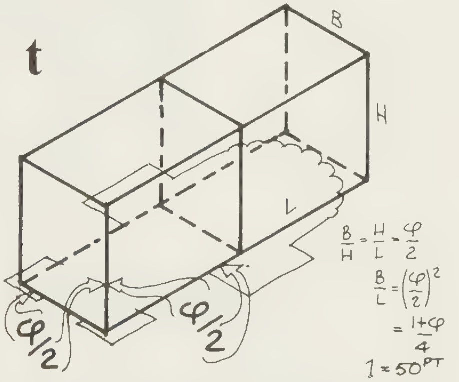
The high roof, Bronze-c, 1222

The ridgeline of Bronze's roof formed a superb culmination to the cathedral's different geometries, for it sums up the axes and its real bulk in a very beautiful way. At 49,470mm above the floor it is $\sqrt{2}$ times the height of the nave roof cornice, also by Bronze, in **s**. But it also measures seven times the bay and three times the span. As the bay:span relates through the same 3:7 the ridge summarises the first axes, repeating in section the ratios first used in the plan.

As the span was originally located by Scarlet at 48^{RF}, then three times that is 144^{RF}, which is 12^2. So Bronze, by using his own system for reconciling the bay and the span into the ridge of the roof, unwittingly incorporated Scarlet's foot unit into the overall height. Hence at these upper levels the presence of a master's foot in a vertical dimension does not necessarily indicate that that masters was himself present.

Measured to the crypt, the ridge defines the total height of the cathedral by φ to both its length and its breadth in **t**. Reduced by $\varphi/2$ he obtained the full width of the nave measured to the external faces of the buttresses at ground level, and when increased by the reverse $2/\varphi$ he found half the overall length of the cathedral. Thus the bulk of the building, being the length, the breadth and the height taken through the nave, was interpreted by Bronze through a double rectangular solid, each calculated from a $\varphi/2$ series in which the base unit was 50^{TF}. These dimensions could be interpreted as being based on 50^{TF} with modules of φ times 50^{TF} added to it.

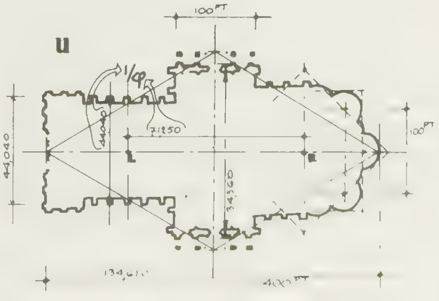
t


B
H
L
$\frac{B}{H} = \frac{H}{L} = \frac{\varphi}{2}$
$\frac{B}{L} = \left(\frac{\varphi}{2}\right)^2 = \frac{1+\varphi}{4}$
$1 = 50^{PT}$
$\varphi/2$
$\varphi/2$

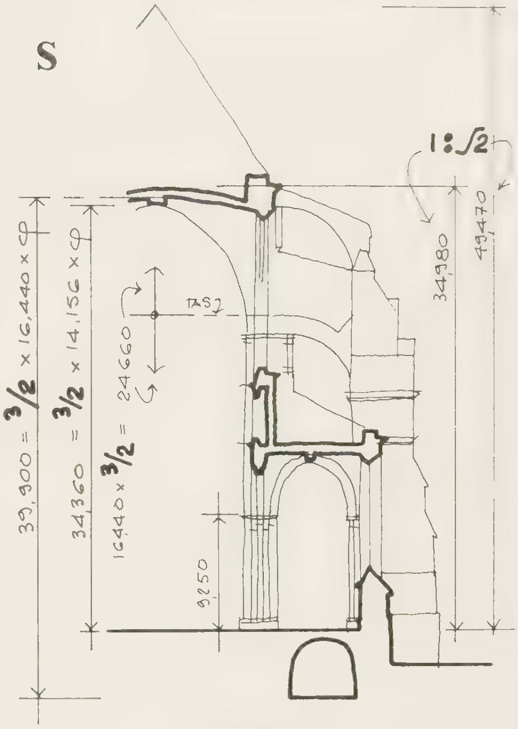
Others in the series in **u** are the length from the labyrinth L to Bronze's location for the rondpont R, to the have breadth by φ (44,040 x =71,250mm), and the bay by φ /2 and again by φ for the arcade capitals (7,066 x $\varphi/2 = 5{,}717$, x $\varphi = 9{,}250$mm, GEOM:XI-A).

In VIII:82 and GEOM:VIII-A/r I showed that Bronze's interpretation of the stonework left by Scarlet after the first campaign involved at first recognising that the overall length of the building (not measured from the diamond around the eastern chapel as Scarlet had done, but from the external face of the chapel itself, to the outer face of the west portal) could be taken as 400^{TF} ($134{,}610 = 400 \times 336.5$mm). The distance between the centres of the two large flanking chapels was made 100^{TF}, and the chapels were enclosed within squares *ad quadratum.* I also suggested he may have made the decision to have porches, for the geometry that resulted suited his overall length *ad triangulum,* and the width of the porch would have measured 100^{TF}.

u



s


$1:\sqrt{2}$
$39{,}900 = \frac{3}{2} \times 16{,}440 \times \varphi$
$34360 = \frac{3}{2} \times 14{,}156 \times \varphi$
$16440 \times \frac{3}{2} = 24660$
TAS 2
9250
34980
49470

The height of the vault, measured from floor to underside of rib, is the same as the length of the transept measured across the outside walls, and was calculated from the double bay by using the same ratio of $\varphi/2$ three times (14,156 x3x $\varphi/2 = 34{,}360$mm), and the top of the vault (also equal to the top of the roof cornice in the nave) is also determined from the bay as $8/\varphi$ ($7{,}076/\varphi = 4{,}373$, x8 = 34,980mm).

The ridge to the floor may also be divided into two equal parts at the top of Bronze's *tas* in the choir (24,660mm) which was itself 3/2 times the span. The span also sits within the vault for the top of the rib to the crypt floor uses the same 3/2 times the span by φ as in GEOM:XIX-B. So the underside of the rib to the floor is the bay by φ three times, and the top of the rib to the crypt is half the span by φ three times, and the ridge is just three times the span.

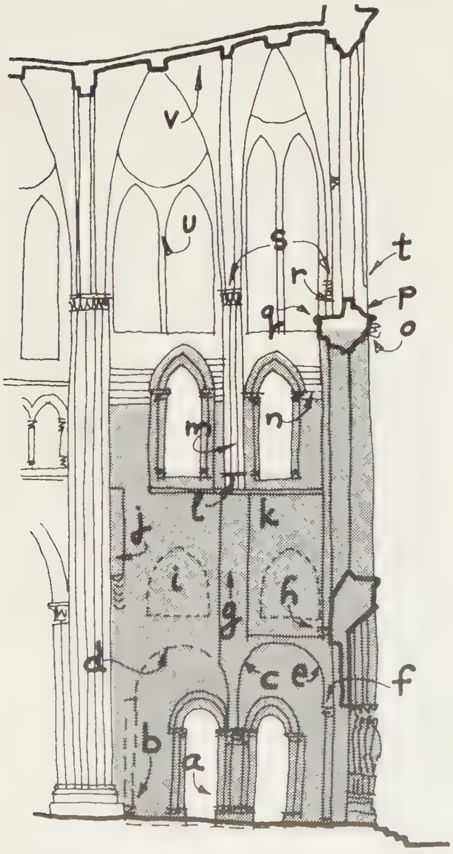
There are very small errors in calculating this series, naturally. In the previous items the two sets were out of step by less than 1 part in a thousand, and when extended to the roof, they were more accurate than that. This is negligible under these conditions.

changes completely. The walls, axes and geometry and all the details alter to follow a new arrangement, yet are invisible from inside.

One is under the footings of the walls across the triforium, level with the underside of the exterior cornice and so some 500mm below the interior passageway. The other is over the clerestory cornice, which is also undefined on the interior, being placed between the upper string and the window sill. Like the shafts and their energies, these planes are not placed within the real building, but form another reality, concealed for their own purposes. The masters were designing from the hidden essences rather than from a visible reality.

We should never forget that the cathedral was built slowly, over decades, and that what we analyse is the result of a long process. It was not an instant job, and so at every step the master had to be aware of what he was going to do many years later. Forethought, so that every level was considered not only in relation to what had been built, but to what was to come. This means that every master had to have some idea of how his final building would look, and the proportions he would use to finish it, before he could make a decision at almost any level. Except for service doors and the windows within the stairs every single thing in the building had to be relatable to an overall concept. Thus the vaults and their cells were no more than the final act of a long-drawn-out and cunningly planned drama where the victors were those masters who were finally able, either through luck or good management, to impose enough of their own schemes on the completed building. Like the covers of a book which are the last items to be attached, they are nevertheless envisaged from the very start.

Once the cells were complete all the master had to do was to render them, strike the last of the scaffolding, and their work was finished. The temporary roof could be pulled out, the windows glazed, and the whole of the central space of the cathedral opened up. The masters could then transfer the full weight of their attention onto the last extremities of the cathedral: the transepts with their towers and the masterful roses which glorify them.[33]



33. *The elevation of the south side of the western bays of the nave.*

a. There are indications against the walls of both towers that there was a vault covered narthex just inside the western doors - n.2. The twelfth century work is shown shaded. There are no rebates to the jambs of these entrances (to either tower). Yet the external entrances to all medieval churches have doors so that ecclesiastic property may be safeguarded, including the lateral external doors out of both towers. The south doorway to the WS tower, and the north to the WN both have rebates for doors. Yet these paired openings give direct access into the crypt. How could the WN tower have been meant to stand alone without proper security? This is one of the observations which suggest that the two towers were both designed to encase a narthex, and though the NW was begun before the WS, it was never intended to be a campanile. See also 'i'. The assymetrical plan for the WN tower (which is not consistent with a campanile) and the facts that in both towers (1) the two west faces are precisely in line though the towers are of different dimensions, and (2) the flanking faces are not placed at right angles to the west, but are inclined inwards **p**, so that when extended eastwards both exactly meet the curved walls of the chapels, both show a unity only to be expected if the north tower had been expected to be part of a grander scheme.

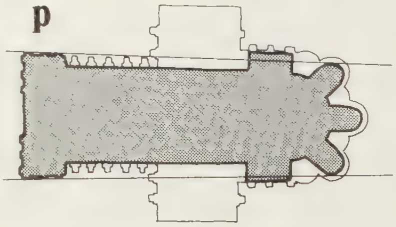
b. The footings for the new piers were stopped against the side of the old columns, without demolishing them, showing that the two west bays of the narthex were still in place. Notice how the footing was indented on the north side.

c. The outline of the twelfth century vaults are still visible on the walls and over the central pier.

d. Perhaps in the sixteenth century the remains of these vaults were modified and decorated with Renaissance egg-and-dart moulding. Villette, 1971.

e. Some new stones, and parts of the old ones recut *in situ*, at the same time as 'd'.

f. The column's base and cap seem to be late medieval. From this I presume that the



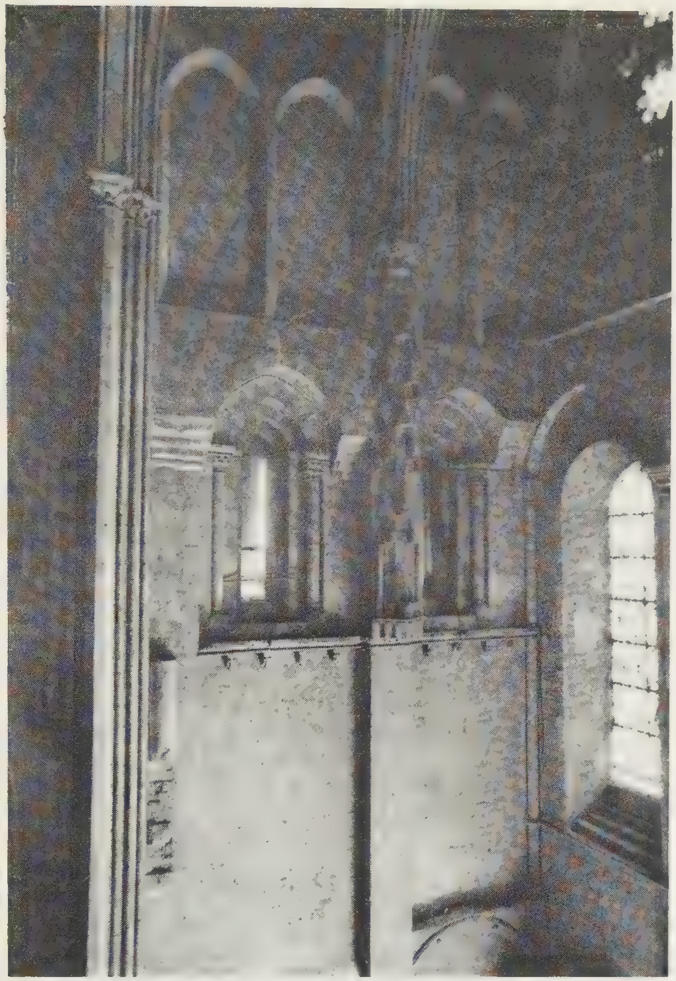


PHOTO 487: The inside of the WS tower, as seen from the nave triforium. The stonework is continuous between the clerestory on the left and the facing over the upper part of the tower. The false windows were once painted in imitation of stained glass.

narthex was removed, and the way was prepared for a new construction. See discussion n.2.

g. The sides of the central pilaster exactly suit the column underneath, and is therefore twelfth century. However what of 'j'?

h. The base to the corner shaft shows the level of the floor over the narthex.

i. On the north side two false windows were built into the tower. The coursing shows that they were never open, and so they had intended to build a chamber alongside the WN tower, for as the WS tower had been started after this part of the WN, they help to show that the WN had not been intended to be a separate campanile, even though it was begun first.

j. The short length of circular shafts next to the thirteenth century pier does not lie over the centre of the narthex column under it in 'b'. It was separated by the vault of the narthex. Was it a part of the room over it?

k. The pilaster 'g' stops at the twelfth century string course. Metal projecting from the underside of the string 'l' shows that the shafts had been continued over the face of the old pilaster *en delit* from the string to the floor over the narthex.

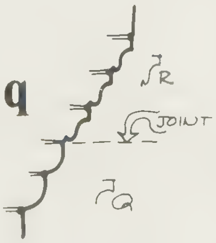
l. The stringmould around the shafts has the same section as in the nave, and is dated about 1207.

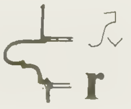
m. Shafts added over the face of the old tower: partly demolished.

n. The face of the tower was moved out with a new wall supported on rows of corbels. The lower ones are full-bellied not unlike Olive's elsewhere. Some of the upper ones are typically Ruby with shallow curves and a small bottom roll **q**, not unlike XVIII:34. Hence these walls were begun by Olive-Q followed by Ruby-R, and the arches over the openings by Cobalt-S which would have brought the work to the top of the west lancets ready for 'o'. Notice how the work of Olive to Cobalt is in line with and forms a continuation of the clerestory work in the adjoining bay of the nave.

o. On the outside below the rose there are two animals resting on capitals. The caps have undercut leaves, berries and the sharp forms of Cobalt, and have his complex impost. Over one capital is a lion mauling a grizzley human head which I would tentatively give to Scarlet after his other lions in N.wL δ 2,3. The horse over the other capital may be Red from the not dissimilar figures in the north porch -XVI:38/T5.

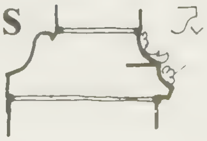
q





r

s



p. A band of leaves which is lobed and drilled like Scarlet-*Shelly*.

q. Inside string moulding like Scarlet's under the south gallery .

r. The inside of the rose is surrounded with Scarlet's corbel **s** in campaign 'V' in the lower half of the circle and 'Y' in the upper. There are only slight changes in the surrounding leaves outside - XX:24.

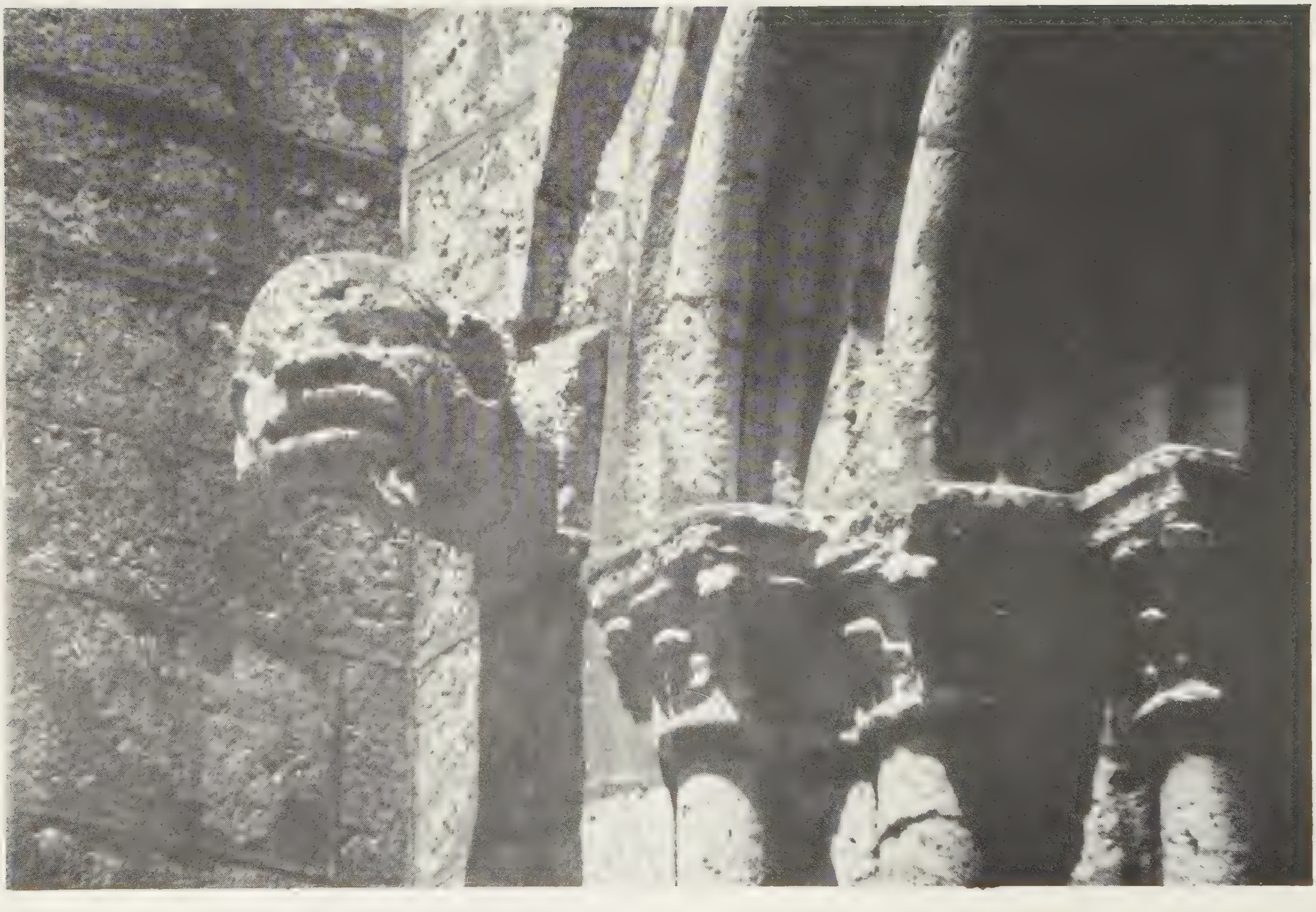
s. Capitals by Scarlet and Ruby - XVIII:53.

t. Moulding around the square frame outside seems to be Ruby's type - V:9.

u. The false windows used to be painted to represent stained glass. Some paintwork still remains. The lancet springs suggests Scarlet-Y, as in XVIII:6.

v. The vaults were raised 710mm and 1300mm above the others in the nave to accommodate the large rose window. The top of the rose is 35,340mm from the floor. This is 100 of Scarlet's PM, and 120^{RF}. See discussion in GEOM:XVIII-E.

PHOTO 488: One of the heads set over the openings of the NW tower in about 1237.



TWENTY

The transepts and their roses

Certainly we can dispose of the old canard 'Form follows Function'. Form follows nothing - it is integral with all processes.
Ian McHarg

The main problem in dating the work done after the nave vaults had been completed is that we do not know when any of it was finished. Above the level of the clerestory walkway the transepts could have been constructed independently of the rest of the building. There is no incontrovertible proof that they were built together, or one facade at a time. Similarly in the apsidal towers above the arches which connect them to the choir, we cannot be sure they were built with the transepts or at some other time.

After the choir had been vaulted work seems to have continued at a steady yet diminishing pace for some decades. There are nineteen distinguishable campaigns between 1221 and the top of the transept roses, and another thirteen can be identified after that - as many campaigns after the completion of the nave vaults as there were before. Without any terminal dates like those we had for the vaults it would be rash to assume that the masters continued to replace one another on the same annual basis as before. However, with a few reservations, I shall continue to assume annual datings at least up to the time the north transept vaults were completed in 1242, for up to this point every one of the contractors had worked here before. As many of the crews after that date are new I have adopted a different method of dating the last parts.

Naturally the margin of error in the dating will increase the further we are from the nave vaults of 1223. As long as you remain aware of the shrinking reliability, the dates given will still help to relate the programs to one another and may provide the clues we need for other buildings, from which we may in time gain the additional information we need to be more precise.

You will have noticed in any case that the higher the building rose the slower the work seemed to go. There are fifteen teams up to the triforium, followed by over twenty to the roof and another thirty or more to the gables. Not only were there more arches and scaffolding in the upper levels, and not only were the stones being raised higher than before, but the flow of essential moneys seems to have been decreasing. The cost analysis of the work done for each campaign shows that after 1223 the amount of work being done each year was dimishing. The funds were drying up. A local historian has described this very well:[1]

"The twelfth century was a time of progress. Towards 1200 Chartres and its countryside was at the peak of their prosperity. Feudal society had by then lost its brutality, bureaucracy and taxation were still embryonic, and the soaring population was less of a menace than a stimulation. It was in these circumstances that the workshops for the new cathedral were re-opened.

"In the next century - between 1220 and 1320 - the area stagnated. All the arable land had been taken up and the last important reclamations had been made before 1230. During later times people referred nostalgically to the 'bon temps de monseigneur Saint Louis.' Though the peasant gave the countryside most of its characteristic traits, they were not able on their own to materially increase either their production nor the area of their cultivation. Far from the major highways Chartres and its district could not hope for further commercial or industrial prosperity: money continued to hold a secondary place in the economy. Situated too far north for wine growing, but too far south for cloth, they were unable to mix in a bigger world. It was not that mental attitudes were unfavourable to innovation, but that social inertia ensured that servitude would be retained.

"Basically the Chartrain region had prospered from the naturally rich countryside, but at the same time suffered from being outside the mainstream of commerce. The fertile soil ensured an ample harvest, but progress ended as soon as its sole nourisher, agriculture, stopped advancing. Sheltered from great distress while being seldom visited by times of glory the region was thereafter a place without a history."

The work on the cathedral inevitably slowed down as its financial base was eroded, and this has made the uncertainties in this analysis of the later parts worse than anything before. In the tower rooms we had too much

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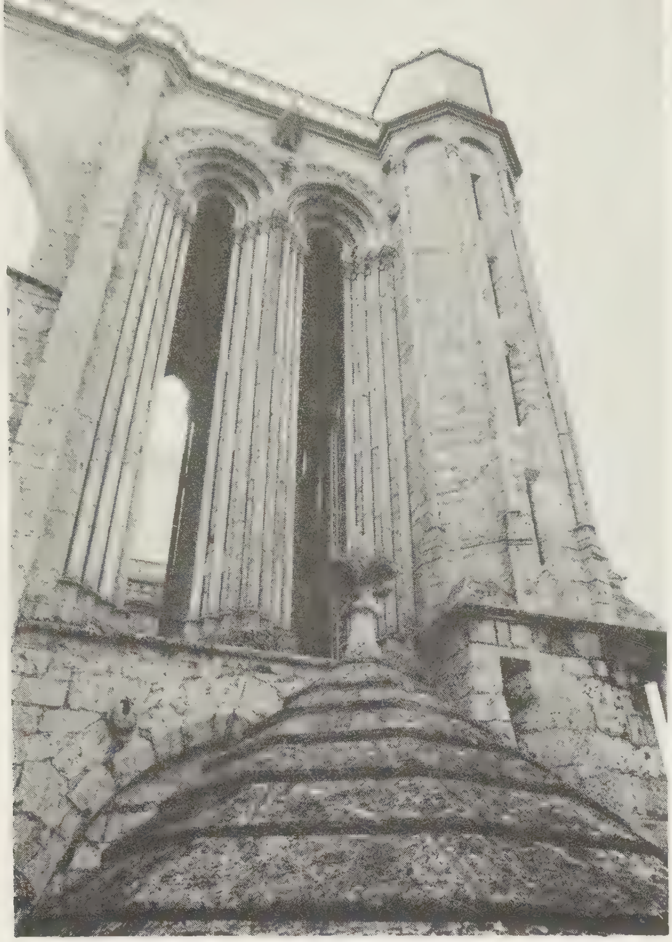
[1] Chedeville, 1973, p.524-5, translated by James. The problem seems to have been a national as well as a local one. See also James, 1972 and graph in VI:45.



information. Here there is too little: few corbels, not many windows or decoration, and much that is inaccessible like the roses, the ribs and the bosses. So I began by collecting all the information I could in exactly the same way as I had in the rest of the building. I looked for changes in angles, sizes and coursing. I plotted and measured the shapes of the windows and doors, cornices and column bases. And once I got into the leaves I ascribed them to their gangs wherever possible.

I then drew the six elevations of the stairs which are illustrated in this chapter. I marked on them every tread, every window and so on, all the changes and each crew which had left something which could identify them. At the bottom of each drawing I began with the attributions discussed in the last chapters, and from that base I began to climb up the facades course by course with the masters.

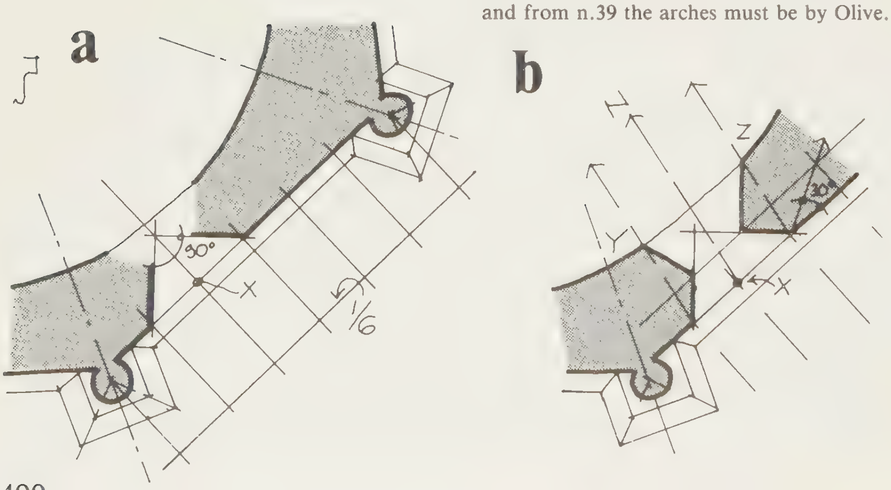
On separate sheets I listed each item for the dossiers which had to be consistent with the ones collected earlier. Naturally one influenced the other, but the arrangement described in these drawings is now consistent in almost every particular with the work the same crews were doing before. Consistency is the basis for this work, and consistent the dossiers now are, even in the transepts.

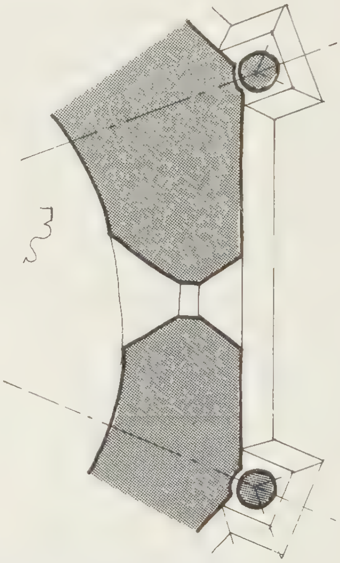
We know that by 1218 the north was some five meters behind the south, and only a little behind the eastern

PHOTO 490: The octagonal enclosure around the stairs of the EN tower, taken from the east. The four upper windows are identical, and were set out by Bronze between 1221 and 1230. The larger window at the bottom is Scarlets', along with the steep stone roof in the foreground.

2. Windows ES.142, 158 and 176 are by Ruby. Divide the side of the tower into six parts, and form the outside of the window from the second and third part as in **a**. The sides make a right angled triangle. In **b** draw the line from X to the newel, and the outer two Y and Z parallel to that. From one of the sixths form a 30° triangle to fix the centre of the window C. Join Y and Z to the first triangle through the line C. At no point has the foot measure been used, but all has been done by simple subdivisions. The style of the geometry is not the same as Ruby's earlier work, though the window shape and the general approach is not too different.

The capitals to the arches which complete the top of the staircase turret are Ruby-*Frills* and *Braid*. As there is a joint at the window head and from n.39 the arches must be by Olive.





3. Window EN.142, 159 and 175 follow the pattern used by Bronze in EN.126. The geometry is discussed in XIV:13. Notice that they are placed on the eastern face of the tower, while Ruby's in the south are on the oblique SE face. Above the topmost window the arches capping the top of the stairs are cut from a single stone with a 'v' shaped recess in each corner as if they had intended to finish them with gables. There is a similar situation in the transept turrets - XXI:21 - so by the same Bronze? The roll-mould round the arch is much more open on this side, compared to the ES.

towers. From here on I have assumed, unless there was clear evidence to the contrary, that the masters continued to work as they had in the past to raise all the parts at more or less the same pace. I could therefore link joints across the building in the sequence in which they occurred in each pair of towers. Without this assumption many of the attributions would not have had enough evidence to hold them up.

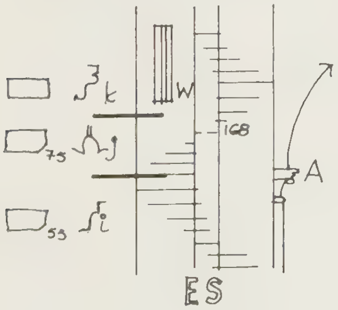
This assumption is not completely unjustified, for with the exception of the northern doorways there was not a campaign that did not add something to every part of the building. No matter how little was done, work was never completely halted in any section. Even in the least urgent areas I found evidence for something from every crew, even if it was only a single course.

The simplest first step was to analyse the windows. In the ES tower all three of them above the clerestory are identical, and are placed exactly over one another.[2] Yet the stair is not the work of one master because between the upper two windows there are unmistakable signs of joints. It is the same in the EN tower, though we now have four similar windows, not three. The upper three are identical to the one next to the clerestory door which I examined in chapter XVI and attributed to Bronze.[3] Level with the EN.142 window the treads inside the staircase change, for the splay on the underside is eliminated and the stone finishes square. These squared treads continue to the top of the tower. The joint seems to lie under the window, for instead of having a carved sill like the others, it sits over a flat stone suggesting it had not been intended in the course below. The holograph above the sill is smaller, the stones were outlined with a chisel before being finished, and the surface is covered in deep scour marks.

In the south the treads also lose their splay, but at tread 168 just below the uppermost window.[4] The splays below the square ones average 75mm for a few courses, and then reduce to 55mm. This change coincides with the level of the capital under the tower vaults.[5] As in the aisles the complexities in vaulting the towers took a number of campaigns to resolve. One was needed to build the ribs and leave them to set, a third to continue the walls and arches around the vault, and a fourth to finish the cells.[6] So we should expect, and in fact do find the same arrangement in the north, though the crews are different.[7]

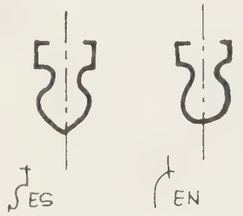
It is quite extraordinary that in such a random sequence of crews the same ones should have happened to carve their windows in just one tower. It did not happen in the southern transept stairs, but we find the same thing in the north to an even more marked degree. From the level of the aedicules to the roof all the windows are the same. Twelve windows one above the other executed from the one templet![8] Is the entire northern front

4. This is a diagrammatic section through the top of the ES stair. The location of the square treads and the different splays are marked on the left. The square ones are the work of Bronze-k in 1230 when he was also working on the south transepts by treads 170 and in the north around tread 120. In both of these places he was building treads with chamfered corners, so why did he cut them square here? Was it because the diameter of the apsidal stairs was so much smaller than the others? The window W was placed after Bronze's treads. The arch caps are marked A. See n.40.



5. Some of the splayed corners are mixed in with the square ones showing that some of the former had been carved earlier, but were not laid until the next campaign. The size of the newel is decreased from 410mm to 380mm which is the Green foot unit. The staircase which had been working to Ruby's 17 treads per turn becomes a more regular 16.

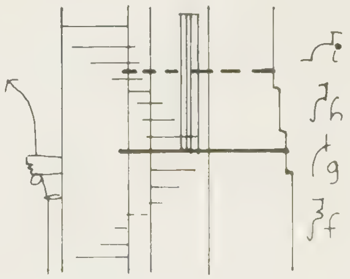
6.



6. I have marked each of these teams on the drawings in n.40. The windows are Ruby, and between them four other masters were needed to finish the vaults. The boss is intriguing. It has the same cusps as in the nave aisles with the simple thick-edged leaves used by Rose - XVIII:53. In the ES the ribs have a deep profile with a pointed section by Ruby, while in the EN it is round with a sharper inside edge by Jade. The ES vault has four ribs, but the EN has eight, and to prevent stilting in the shorter cross ribs their springing has been set higher up. The EN boss may be Green-i. See n.37/**t**.

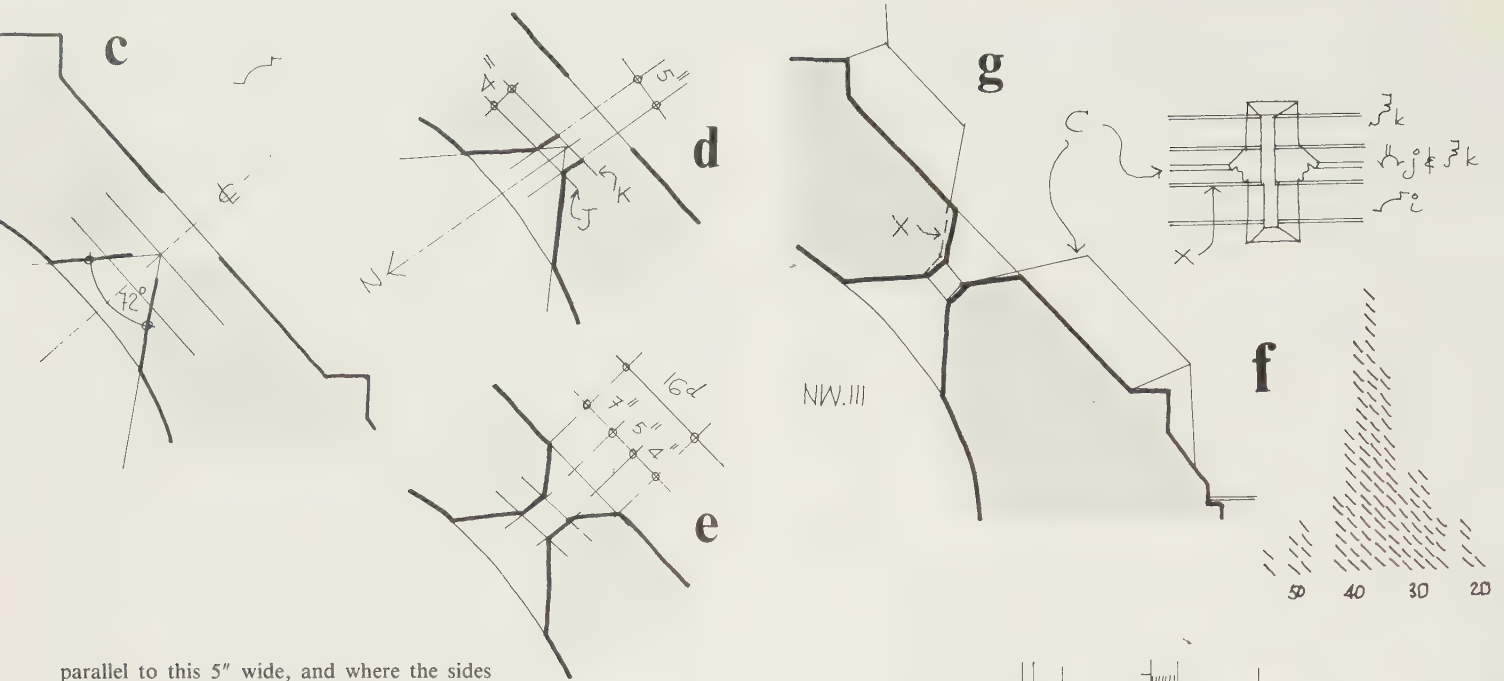
7. In the north treads 146 to 196 have a square-cut under corner, instead of the chamfer normal elsewhere. There are possibly 25 of them from the one campaign. They were not put down at the same time as those in the south in n.4, as can be seen in the section n.40. The sequence of events will be clearer from the isometrics, where it can be seen that while the south side of the choir is well supported along its full length, the north is unsupported in bay I because of the delays in the NE tower.

To compensate for this Bronze, in the year he built the ribs of the choir, pushed the EN tower well ahead of the south so that he would have at least one strong element on the north side while he was erecting the high vaults over the choir. Two years later, after the EN.I flyer had been extended onto the NE tower, Ruby did a similarly large campaign in the south to bring the ES up to the same level as the EN. Notice how the maintenance of some sort of balance across the axis of the choir dictated the order of work.



8. All eleven windows have the same plan. The geometry begins by taking the centre of the wall face **c**, and drawing the perpendicular to it. This is divided into three, and around the outer point draw two radials of a pentagon.

Mark the line from the apex of the pentagon to the right side of the newell N in **d**, which is not square to the perpendicular. Make the slot



parallel to this 5″ wide, and where the sides intersect the pentagon draw the line J, and 4″ from it another K, in **e**. Mark along the outside a contrapuntal 7″ and 4″, making a total outside opening of 16 units, which at 381mm may be his foot of 16 digits. Join in **e**. The offset of the outside triangle to the left compensate for taking the slot to the right side of the newel. The foot could be a 12″ one of 285mm, the Punic, but from other work seems to be the larger one, or its half of 190mm. His windows face the north east in both stairs so that in the NW stair they are next to the rose, and in the NE they are closer to the adjoining tower.

His holograph from such a large area of work is quite clear **f**. His joints are among the most casual in the building, some as thick as 25mm, though most are from 10-15mm. The coursing is even and tends to coincide with the thickness of the treads - two treads per course. The perpends are often over one another.

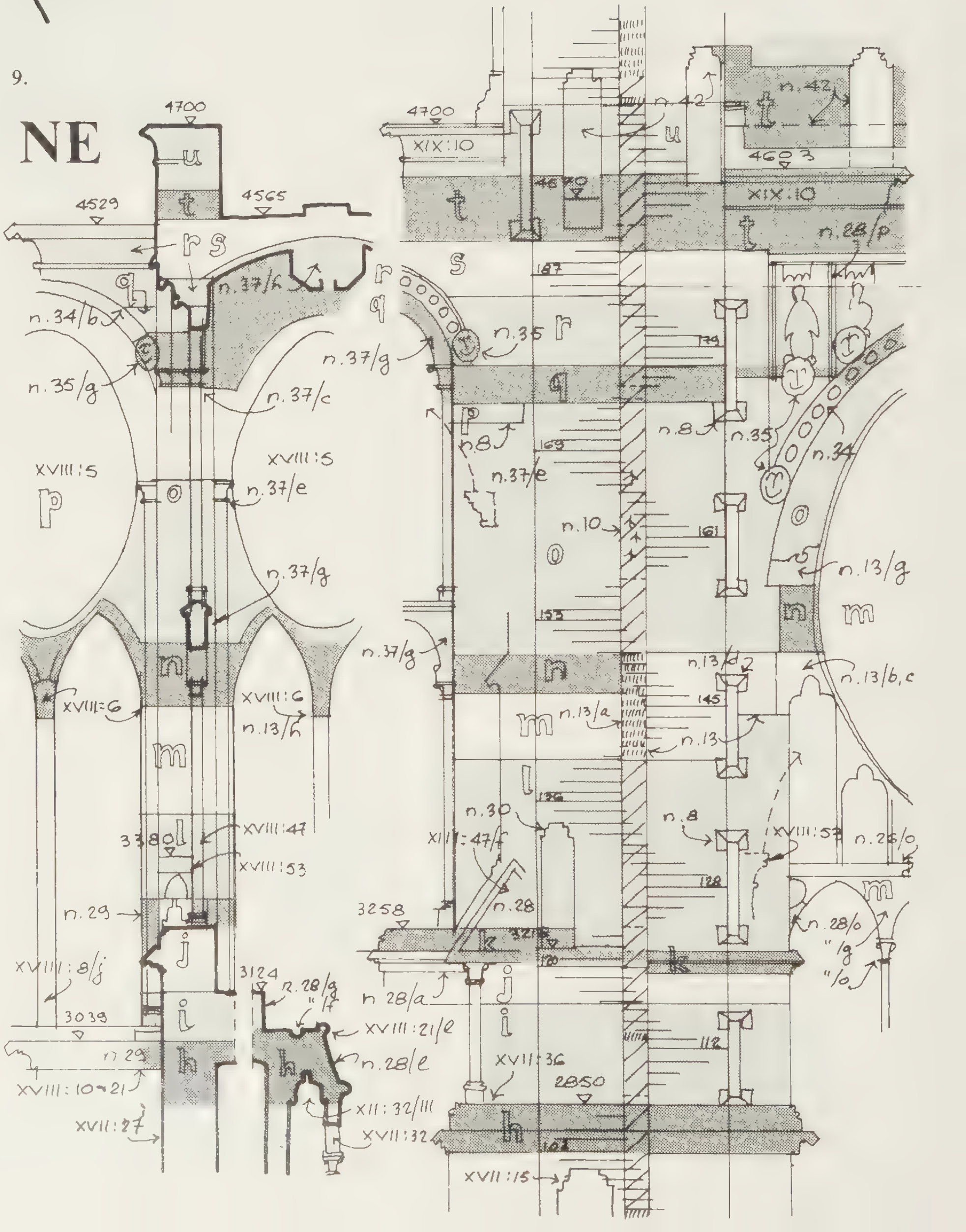
There is no apparent geometry to the height of the windows. Nearly every sill has upstands on either side for the jambs. There is no consistent pattern in their slopes, but they tend to be a shallow 100-140mm.

NE.101 - There is a joint just underneath the sill that rises to the top of tread 108, and then rises again to the course between the corbel Ruby placed over the triforium and the gutter to the tower roof. On the east side the joint is vertical. All treads in this campaign are double except 113.

NE.117 - The joints round the sill can be followed in the changes in the angle of the buttress by the ne. corner of the tower. It begins above the plinth, and steps down to below the sill. The treads alter at the threshold of the (cw) door where the splay under the tread is doubled to an average of 65mm - n.28/**m**. In the inside of the stair the joint rises close to the corbel Green placed over the door, as Bronze's work includes the capital under the vault spring - XVIII:53.

NE.134 - There is a joint from the last double tread 138-9 to the middle of the window.

9.



therefore the work of the one crew? Is this where the piecemeal contracting system was for the first time rationalised, and an entire section of the job given to the one master to carry through to completion?

Can we accept that one crew designed the weighty 'old-fashioned' northern towers, the last of the clerestory windows, the marvellous crisp tracery of the Rose of France, and the sensuous thick-lipped heads which crown it? Sadly, the facts deny the possibility. Though the windows are the same there lie between them, as in the east, unmistakable signs of other men. The joints up the north facade are shown on the elevations which have been drawn from the north. They show part of the rose and a 'section' through the stairs done in the same way as before.[9] Alongside the rose the drawing shows the clerestory walls which run at right angles to the facade. The small plan at the top explains how it has been

The window head has double the slope used by Green, and is by the next master, Ruby. There is another joint over this, lying just over the window head. The topmost single tread 150 lies over the window. On the outside follow the joints to the gusset plates in the tower and to the frame for the rose.

NE.151 - The coursing between the sill and the head is even. The work around here is homogeneous, and was all done in the one campaign, including the corbels for the tower vaults - n.37/e - and the arch and drip over the rose, and some of the heads - n.35.

NE.167 - The same campaign continues up into this window to the course over the sill, and with one of the heads over the rose. The shape of the stairs changes on that face visible from within the tower showing the exact location of the joint - n.9.

NE.186 - Built in his last campaign in 1241.

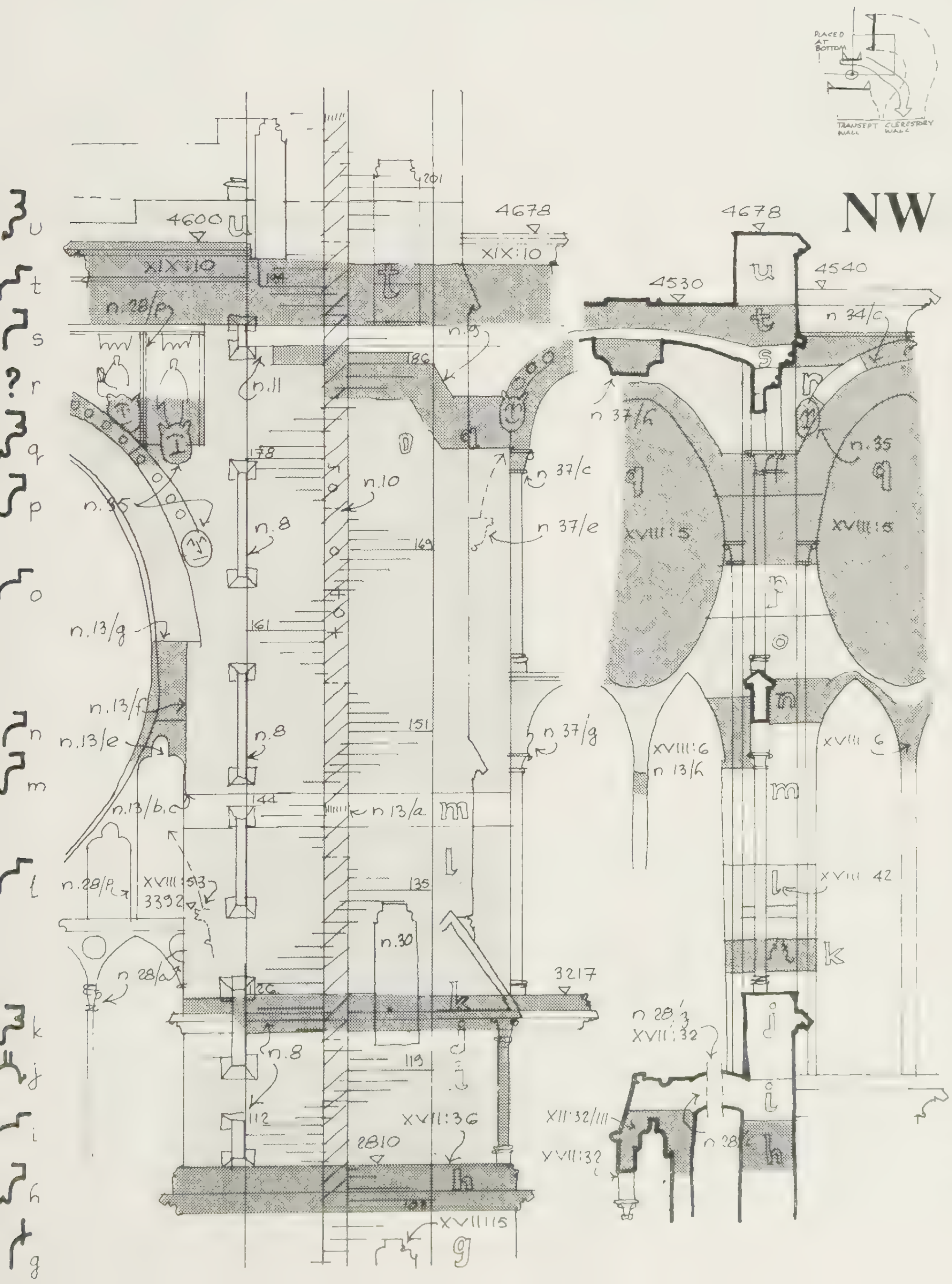
NW.95 - The joint runs from three courses above the NW(t) door to below the sill which sits immediately above the cornice of the aedicule - XVII:36. The corbels over the triforium passage are later by Ruby, being 560mm higher than this sill. The coursing in this area is very uneven, showing numerous possibilities for the joints which lie here. This is the shortest window in the building, being squeezed up against the underside of the treads over it.

NW.III - This window breaks through the cornice **g**. The plan is Green, but the plan changes above the sill at X to form a square slot rather than an angled one. The change coincides with the cornice G - n.28/c. The frame around the lancets under the rose changes at the same point from a square section to a round one. The continuation of the joints can be followed around the tower plinths and bases. The head of this window is by Bronze, followed above the nearby clerestory door with Green corbels.

NW.126 and 143 - They are entirely by Green, with double treads and with one single at the middle at tread 143. This single with the joints around the rose show where there was a break in the work. The single comes over the lower window with clear vertical joints on the east.

NW.161 - This was built with one of his staring heads next to the rose, and with rosettes in the drip mould - n.34.

NW.179 - See n.11 and text.



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[9] The diagrammatic stair drawings in this chapter are seen from the outside, unlike all previous examples. In this note they are drawn from the north, in n.32 from the south, and in n.40 from the east.

The rose is placed in the centre of the drawing, with the stairs. The outer parts of the drawing show the first bays of the transept clerestory, and at the bottom the section includes the transept in bay III. Double stairs are shown with an oblique as before, but singles are hatched to emphasise them. The RL's are shown over triangles. None of these drawings are to scale, or in proportion as it was more important to make them as clear as possible.

arranged. Between the first Green window in 1228 and the last of his corbels in the middle 1240's there are fourteen crews, only three of whom are Green! Not a section of the stairs is built without a window. Some of them are only a few courses high squeezed up under the soffit of the treads above, others are cut through the middle of cornices parting them like a knife. Green is ruthless in his pursuit of light.

His treads are massive. Two are cut from each stone using blocks about 380mm high, which is his foot unit. His workmanship is crude as his men worked with axes more often than chisels, chopping away at the surface of the stone, leaving a pitted and uneven surface. Some of his men have left masons marks,[10] but only in the one campaign during which he arched over the northern rose window, built the stairs on either side, began the vaults to the towers and carved some of the funny heads around the top.

There is no doubt that the lower heads are his, for one of them is built with the sill to NW.179. On the other side of the rose just above this level you can see where another crew changed the silhouette of one of Green's windows.[11] There is no doubt here. Just pay your three francs to the Guardien and climb towards the spectacular views from the tower, and before you emerge out of the stairs stop and look at the last window. Do the same from outside with binoculars, and the courses show that Green's work ended just under the heads projecting above the tower arches on the west side.

From the windows it would appear that Green had proceeded up the north facade with only one break from tread to 123 to the top of the tower at tread 185 or thereabouts. That would have given sixty treads, or thirty courses to the one master. This is not to be found anywhere else in the cathedral, and would mean that the real bulk of the north front above the tower plinths had been done in two campaigns. They are such hefty programs they must have taken more time than any others, for there is no reason to think that there had been a sudden surge of funds at this time. Rather, it looks like a small crew which was able to work within the moneys available without building themselves out of a job, who slowly but steadily concentrated on the one task of finishing the north. For at this time the rest of the building had been completed including the south front and the apsidal towers. All Green's limited energies could have been devoted to this one task.[12]

This may be an indication, as we have found elsewhere at this time, that conditions were changing and that the old contractual methods were being modified under economic stress.

But for me the really fascinating question is, did Green do this rose which is the most melodramatic in the cathedral? I have pondered long and hard over this question. Green's whole approach to his craft seems too poor technically for him to have done it. Certainly he could have had a few first class cutters in his team, but the feeling I have for him and his artistic spirit does not fit that of the rose. His fatuous grinning heads, his heavy handed use of the laye, his leafage and rosettes do not square with any of the details in the rose, let alone its spirit.

These are, of course, only feelings, not facts, yet I was glad when I found the evidence to support the feeling: single treads lying like the ham in a sandwich of doubles, ragged joints on the inside where the rose was bonded into the work on either side, changes in the section of the trefoil under the rose, and so on. All are located on the elevation.[13]

The rose is a pre-cut element made from a dozen standardised parts which would have been set up as the wall advanced as a "structure within a structure."[14] It

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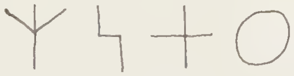
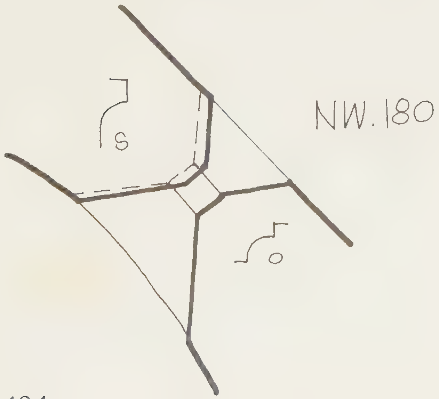
[10] The masons marks lie on treads NE.151-66 and NW.159-83. The latter was the top tread in that campaign. These double treads are working 16 per turn - IV:50.



[11] As this is the stair the public are allowed to use when visiting the WN tower, this window can be examined by everyone. The Green sill has been reduced and altered in the next course, drawn solid. The joint can be seen to step down from the east to the western side of the window slot. From outside the joint can be followed on the east along the wall behind the statues, and on the west to under the arches of the tower.



[12] This may have been happening fairly often in the 1230's. The triforium at Reims seems to have been built in a single large campaign by one of the masters in the Red group using a corbel like Ruby, and windows like Bronze. Yet around him, both before and after, lies the evidence for the same small campaigns as at Chartres. The Reims triforium may date from the early '30's like Green's work at Chartres. See ch. XXII. The elevations in n.9 show that the stairs were at this stage 4 meters above the adjoining clerestory window, presumably to allow for access from the crane to the inside of the rose. It took three more campaigns for the tower piers and windows to catch up, and consequently this window was not continued until Olive-s in 1240.

[13] Here is the evidence for the break in the middle of Green's mammoth campaign and are all marked on n.9:

a. Single treads NE.140-50 and NW.143. More treads had to be laid in the NE stair as they lie on the west side of the newel and were needed to support the stones of the rose. On the NW the rose could be erected without the treads. This suggests that the rose master was conserving his funds by restricting his work to the tracery itself. It also shows that the NE was ahead of the NW by the end of this campaign.
b. The wall under the trefoils under the rose changes in outline. There are two very large vertically placed stones above this change.
c. On the inside of the rose the splay in the wall alongside it is widened. This is level with the bottom of the trefoil. The *tas-de-charge* ends in the next course, marking the natural location for the break.
d. The change in the head of the NE.134 window - n.8.
e. The walling under the trefoil on the west changes in plan.
f. There are vertical joints within the stairs.

need not have been installed by the same master who carved it, yet if it was carved and mainly set up by the master of the single treads, his work was almost entirely limited to the rose itself.[15] He did almost nothing else: a few treads, a window head, and one or two courses here and there. Just enough to start setting up its frame and the erection of the lower components.

On either side of the rose is the heavier rougher work of Green who had proceeded as far as the centre of the rose before he was ordered off the job for a while so that another could carve and start erecting it. Then, only a few courses later, Green came back to continue to the top of the tower. Had the Chapter decided they did not want one of Green's roses? Had they considered his scheme for the rose, rejected it and sought elsewhere for a better one? I am particularly fascinated by the thought that the Chapter had asked him to leave the job for a while so that another crew could carve the *piece de resistance.* Did Green resent it? or was he a more modest local builder aware of the inadequacies of his own men?

The right to carve a rose must have been a grand privilege accorded to few masters in France. For how many roses are there from the hundred years that separates the massive thick plates of the Laon north rose to the filigree network in the Reims transepts? Few more than twenty of which over half were carved while Chartres was being built. The north and south roses at Chartres are particularly alike, consisting of a dozen spokes radiating from a central wheel which supports a large circle, and outside that even larger half-circles. These shapes are interspaced with four-foils made as large as the spaces will allow. Many of the details are identical: the octagonal shafts with their curved sides and intricate twisting leaves[16], the re-entrant mouldings around the four-foils, and their button-like rosettes the under-cutting of the string-course around the circles, and the shape of the column bases.

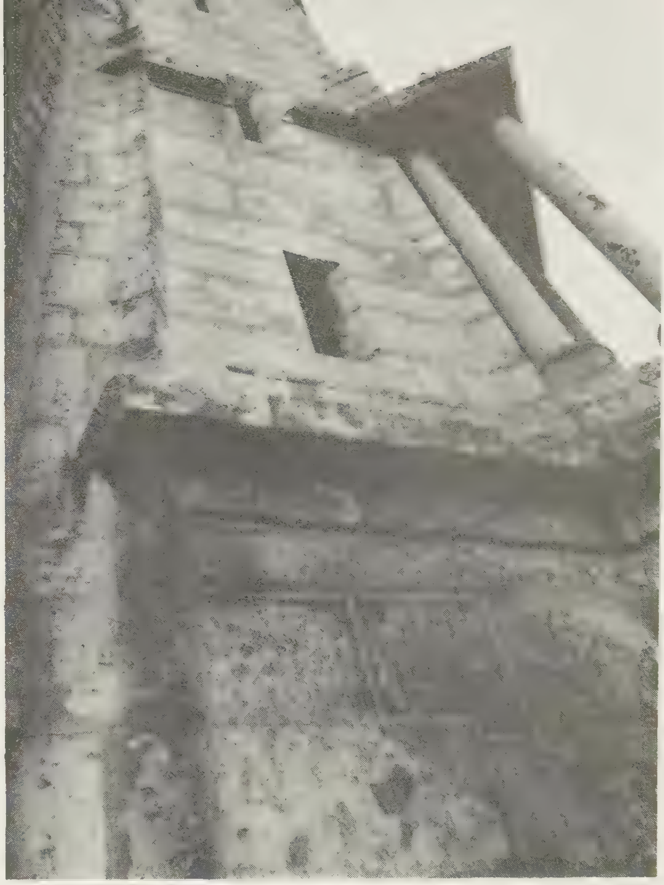


PHOTO 495: Green's windows out of the NW tower stairs.

Surely they are by the same team, though not at the same time. The order of work shows that the northern rose was carved in 1233, and the southern may have been begun four years earlier in 1229.[17] The southern one is a coruscating jewel which shimmers like jasper before its mentor the sun. This is the Bishop's window, which as

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The arrangement is easier to read in the NW, and more difficult in the NE.

g. The arch over the rose does not grow out of the wall, but is set over small figures carved over the flat top of the wall. Both are worn. The one in the east seems to be a crouching animal, the west a cross-legged figure with the head missing - work of Green.

h. The changes in the pattern of the lancets under the adjoining clerestory roses -XVIII:6.

i. For the way these joints relate to one another see n.9 and n.15.

[14] As Frankl said, 1962, p.88.

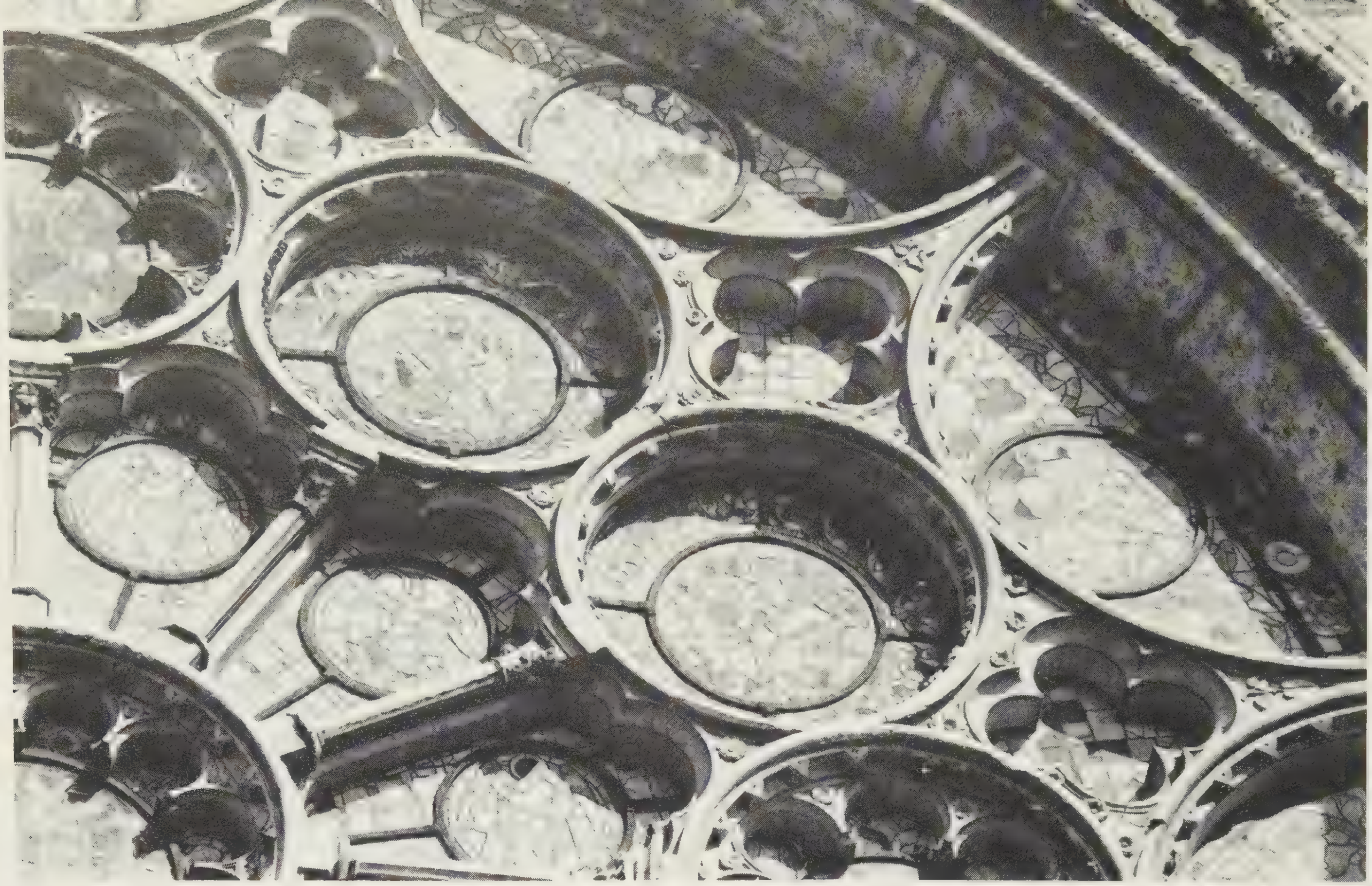
[15] I do not think that the rose had been prefabricated and brought to Chartres from another place, as its frame ties into the wall too precisely to have been made elsewhere. The centre of the rose may have been cut at the 'factory' if the frame which bound it into the building was carved on site. These framing stones are each individually organised to suit the surrounding courses, they relate to the single treads within the stairs, and predictably its shape does not coincide with any of the mouldings used by Green.

[16] Shafts like these are only to be found in the *jubé* - XVI:40/b. The stones of the roses were largely replaced around 1900, but the originals still lie in the WS tower, and they show that the new work follows the old exactly.

[17] The possible dates for these roses have occupied much attention. This is mostly based on dates for the glass. The glass could have been made any time after the stonework for the windows was cut, as templets could then have been made from each opening. The glass would have taken some time to design and make, though perhaps not as long as the two years François Lorin took to make the SE.III window in the aisle which was donated by the American Institute of Architects in 1955. Dr Madeline Caviness wrote to me, Nov. '79, on Canterbury that "templets would have to be taken - a Romanesque window head might be filled out with a border afterwards, but that would not work for a pointed arch, and the fit is usually very exact. The break-down of hands at Canterbury seems to show that they were keeping very close behind the masons."

Most scholars begin their analysis of the glass with the two clerestory windows in the choir next to the crossing which have been dated at 1216 on firmer evidence than any of the others (Delaporte and Houvet, 1926; Frankl, 1961; van der Meulen, 1965). The templets for these lancets could have been made as soon as Cobalt began the arches over them in 1219, though the lower stonework was in place after 1215 - XVIII:6. The date from this glass comes from the death of Canon Brou who is commemorated in the window, suggesting that he left the money for it in his will. Even if this window had been commissioned as early as Ruby's jambs in 1216 the upper limit would not have been fixed until Cobalt's arches in 1219, and it could not have been installed until the vaults were finished and their centering struck in 1226.

This suggests that the money for the glass was being collected before they were ready to prepare the templets, and that the glass was ordered and manufactured during the period between the building of the window and the



completion of the vaults so it could be installed as soon as the builders were finished.

Alternatively, there may have been more than one campaign per year to the completion of the choir vaults - dated at say 1223 instead of 1226 which would have meant that the choir vaults were completed by the time of Guillaume Le Breton's poem. On this condensed schedule Canon Brou's 1216 donation would have coincided with the arch over the lancet. See.I:7.

I have summarised in the adjoining drawing the dates on which the templets could have been made for each window, and in brackets the dates the vaults over them were finished to give the years within which the glass would most probably have been made. Of course this drawing is not to be taken as proof, for some windows may not have been finished until many years after the vaults; though remember that if this was so, the clergy would have had to pay for temporary glazing, and the armatures to hold it. As the armatures are made to suit the design of the glass I would think that they would have avoided temporary glazing if possible.

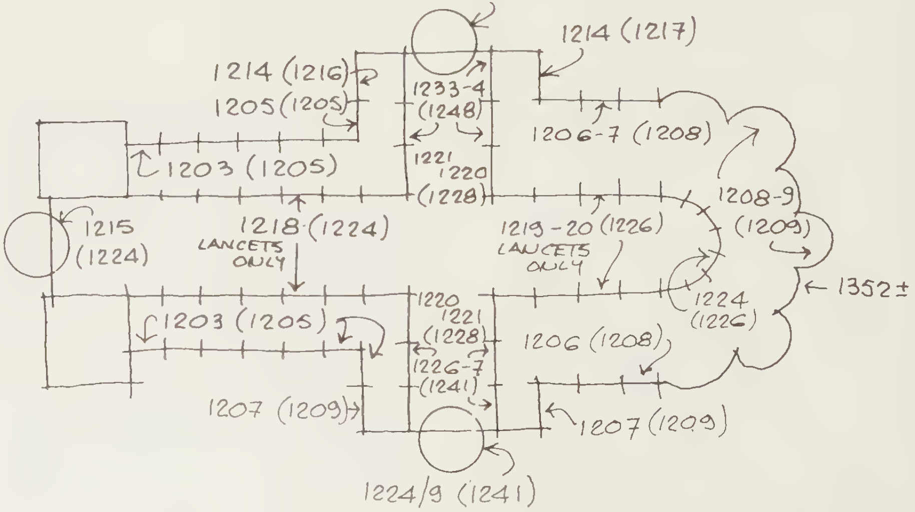
The dating of the windows from inscriptions or documents is a useful check on the building history, but in no way can we reverse the process to use the dating of the glass to date the stonework. As the roses have been most thoroughly discussed, I shall say something on each one.

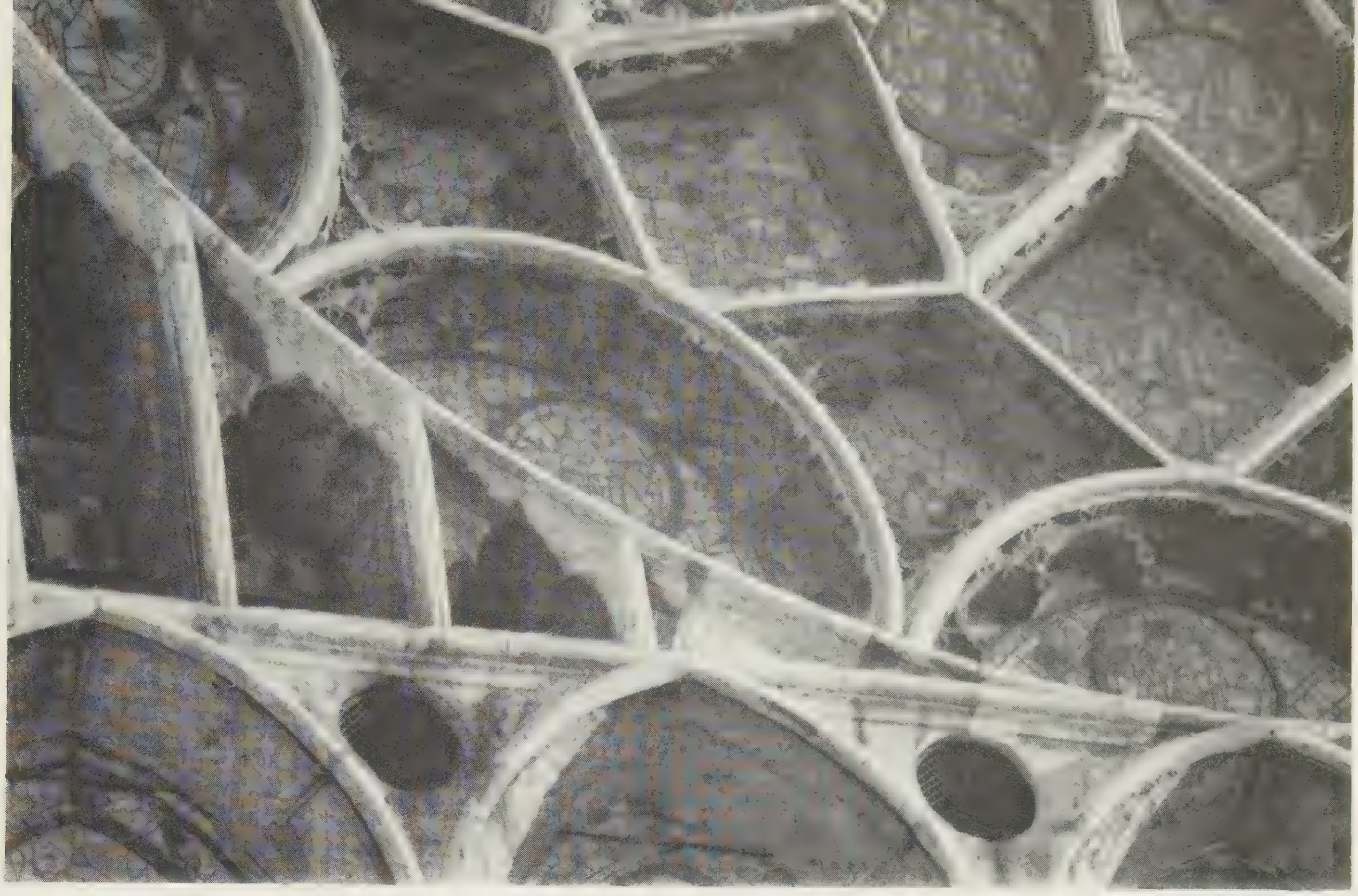
The west rose: There is nothing in the glass to permit dating. However in James, 1973(2) I wrote that in the outer circles of the rose the inner frame including the cogs are set "like a sleeve within a ring. They were carved separately to their frames so they could be rotated to keep the eight leaves of the octagon constantly vertical. I do not doubt this was done to suit the glazier so he could place his figures vertically like the cars in a Ferris wheel. Such a device is an illustrator's not a geometer's. Rigorous geometry should have led the master to fix his leaves in the most suitable relationship to the centre of the rose rather than to gravity. For this reason I think he may have been influenced by the stained glass master, who would therefore have been working on the site at the same time. If so the glass may have been designed, if not cast, at the same time as the stonework in 1215."

The south rose: Here is a list of the dates given by different scholars based on analayses of the donor and his family history:

1212-17	Sauerlander, 1966
1217-21	Merlet, 1926; Grodecki, 1957
1217-25	Popesco, 1970
1221-	Delaporte and Houvet, 1926
1224-? 1229	Frankl, 1961
before 1230	van der Meulen, 1967.

I estimate that the templets could not have been made before Rose began the lowest part of this window in 1224, and more likely when





PHOTOS 496 & 497: The south rose on the right and the northern on the left. Both were by the same master, but where the south is all circles, the north has a ring of diamonds which disturbs its certainty.

they said faces the coming of God in all His resplendant glory:

"The twin windows which display a circular splendour are the two eyes of the church, rightly the greater is the Bishop, the lesser the Dean. For on the north is the Devil, to the south the Holy Ghost; towards these the two eyes look. For the Bishop faces the south that he may receive the one; the Dean the north that he may avoid the other; one looks to be saved, and the other lest he perish."[18]

The southern rose is all circles, calmer than the more crystaline twirling forms of the north, and their forms underlie their ritualistic meaning. The north is the Chapter's window, being on the left of the building facing the cold northern winds, and with that direction's overtones of sinister darkness.[19] The design is more nervous, perhaps reflecting the Dean's view of the dangers it faces. The southern rose rests in inperturbable glory certain in its rightness, while the other moves like a whirlpool in the suffering that choice imposes on all living things. In the south the surrounding circles emanate feelings of sureness, for only four of the twelve are picked out with internal cogs which tend to give the rose a four-square sense of certainty. In contrast the twisted diamonds of the north vibrate uncomfortably within their circular matrix.

The basic elements of these roses are not unlike the one in the west, and yet they are so different. They are

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the stones were being cut and installed between 1227 and 1229. The lancets naturally could have been begun earlier after Olive's arches of 1223. The glass in the rose could not have been installed before the vaults were finished in 1241 - XIX:18.

The north rose: As for the south the date has been estimated as before 1234 by Delaporte and Houvet, 1926, and by van der Meulen, 1965. But in 1967 the latter threw doubt on this saying "some windows can hardly be dated before the Renaissance". I would estimate that the northern templets could not have been cut before 1233, and that the glass could have been installed after 1248. The lancets could have been begun after Ruby's arches installed at the same time.

In '69 stained glass was costing $\$1000/\text{m}^2$. A lancet window of 20m^2 would take 4-6 people only 2-3 months to make, not 6 as suggested by Frankl. The roses are about 300m^2 each, which on this calculation would take 6 people two to three years - 1215/18 for the west, 1224/7 for the south and 1233/6 for the north.

[18] The "Metrical Life of St. Hugh, Bishop of Lincoln", ed. J.F. Dimock, Lincoln, 1960, p.32-7. It was written c.1225, and was tranlated by Harvey, 1972, p.238.

[19] This is not the place to discuss the symbolism of the cathedral, but just note the tendency to associate insecurity, change and criticism with the words 'left', 'gauche' and 'sinistra', and the opposite tendency with the words 'right', 'droit' and 'destra'. See Jung, 1959; Mackenzie, 1926 and Michel, 1972.

composed of the same parts: spokes, circles indented with teeth, and quatrefoils, and when they are compared to the other roses being built in France at this time their similarities seem more important than their differences. They all have spokes carved with bases and capitals like columns. Their arches are encrusted with rosettes, and they all place circles at the ends of their columns with cogs within them. The internal face is flat and unadorned. But there the similarity ends. Where the south is explosive the west is solid and strong. It is so massive that we might believe that its creator's faith could only have been sustained by the most rigid iron control. The teeth are heavy and sharp edged like spikes. The forms he used are thick and ponderous. The west comes from a discipline that is like a prison in comparison to the south. It is as if self-control can only be maintained by the greatest fortitude and suffering.

These are the traits which stand out when we compare it to the transept roses, particularly the southern. For the latter is the opposite to all these things - effervescent, joyous and sparkling it effortlessly carries itself. In ecstasy it glories in the sun's joy. I could not imagine a greater contrast between the spirit of these two, similar as they are. Both are supreme creative works: but one is a Michelangelo where the other is an Angelico - the one a St. Anthony and the other a St. Francis - for are not both torment and joy equal aspects of the Christian faith?

The western rose is the work of a master using the Ped Manualis with a love of mass and weight.[20] Who else but Scarlet whose column-spokes in the nave made its flyers such massive things. The columns in the rose and their bases and capitals are those of the flyers, the geometry and the fascination with mystic numbers are those of the first plan for the cathedral.

A unit of this size would seldom be the work of one team, though it could have been designed by one. Once the design was finished Scarlet would have completed enough for other men to follow him, for I can see that at least three crews worked on its spoke capitals. Though some have been replaced, and one was chopped about and put in upside down, I think I can distinguish the work of Scarlet, Ruby and Bronze which would date its execution between 1215 and 1217.[21] The inside of the rose is framed with a moulding shaped just like a Scarlet corbel with lobed acanthus-like leaves on the outside that I could not put with any other gang's work than *Shelly's.*[22]

While Scarlet and the others were working on the flyers in the clerestory they were carving the similar details in the rose nearby, and many of the same gangs worked on capitals in both places. I think that the wall around the rose was begun by Rose-U,[23] but from the ragged junction between the bottom course and the lowest part of the rose's frame Scarlet may have cut back the earlier work to make the opening larger. Rose might even have intended to put in nothing but a small oculus, for the vaults had to be pushed up by over a meter to accommodate the one Scarlet put in. The erection of the sturdy scaffolding needed to hold it into place until the arch over it could be set up would have been quite an immense job in itself, and could have taken the whole of Bronze's campaign and much of the next to complete. As the next master was Scarlet again, this may explain why the whole of the frame, with its leaves and the corbel on the inside appear to be by the one crew.[24]

No rose was a one-off design, but appears to have been carried with the master as part of his repertoire which he could improve and refine as time and leisure would permit. Just as the four windows into the lobby's of the circular stairs shows Bronze enriching his geometry more and more as he repeated the work, so the repetition of the same rose design over many years could have stimulated the master to enrich and refine it until he could give us the integrated elegance and complexity of this rose.[25] The more it was worked on by generations of masters the more it would become a marvelous jewel in their hands, a canonic statement of their faith.

Then who designed the transept roses? It could not have been Scarlet, that's for sure. I am inclined to think that they held a competition for the south, perhaps under the aegis of the Count of Dreux whose family appears in the stained glass. You can imagine them sending round to the nine masters who had already worked on the cathedral and asking each of them for a scheme and, perhaps, for an explanation of the subleties and meanings that went into it. Persuasion and brilliance, presentation and the inevitable play of personalities would have helped make the choice. Imagine a gathering of all nine masters on the site, brought together by the Building Committee to explain their concepts, perhaps even while one of them was working on the site preparing the lower frame for the tracery.

A few of the best would have been selected for presentation to the entire Chapter and the Bishop, and the choice made. The Ruby-Rose team![26] Once chosen the same master would inevitably have been consulted on the north, and possibly appointed without competition. I think this may be why the work around the north rose is so open, for he would have been in time to suggest that the window wall be continued from the top of the lancets to the rose itself. It was too late to do the same in the south for the solid walling over the lancets had already been started by Bronze and Olive some years before.

At the time the southern rose had started, the work in the north had only reached the beginning of the towers. The arches over the facade lancets were begun in the same campaign so that the design of the space under the rose could have been modified to suit the new ideas accepted in the south. The influence of the competition was already spreading beyond the circle of the southern rose to affect the entire form of the north facade. The diaphanous end wall of this transept has helped to give Chartres another of those felicitous contradictions which seem to give it so much of its mysterious character.

The two roses, though by the same crew, are full of contrasts. All through the day the sun shines through the southern one emphasising the pure circle of its form set against the solid walling which surrounds it, while the

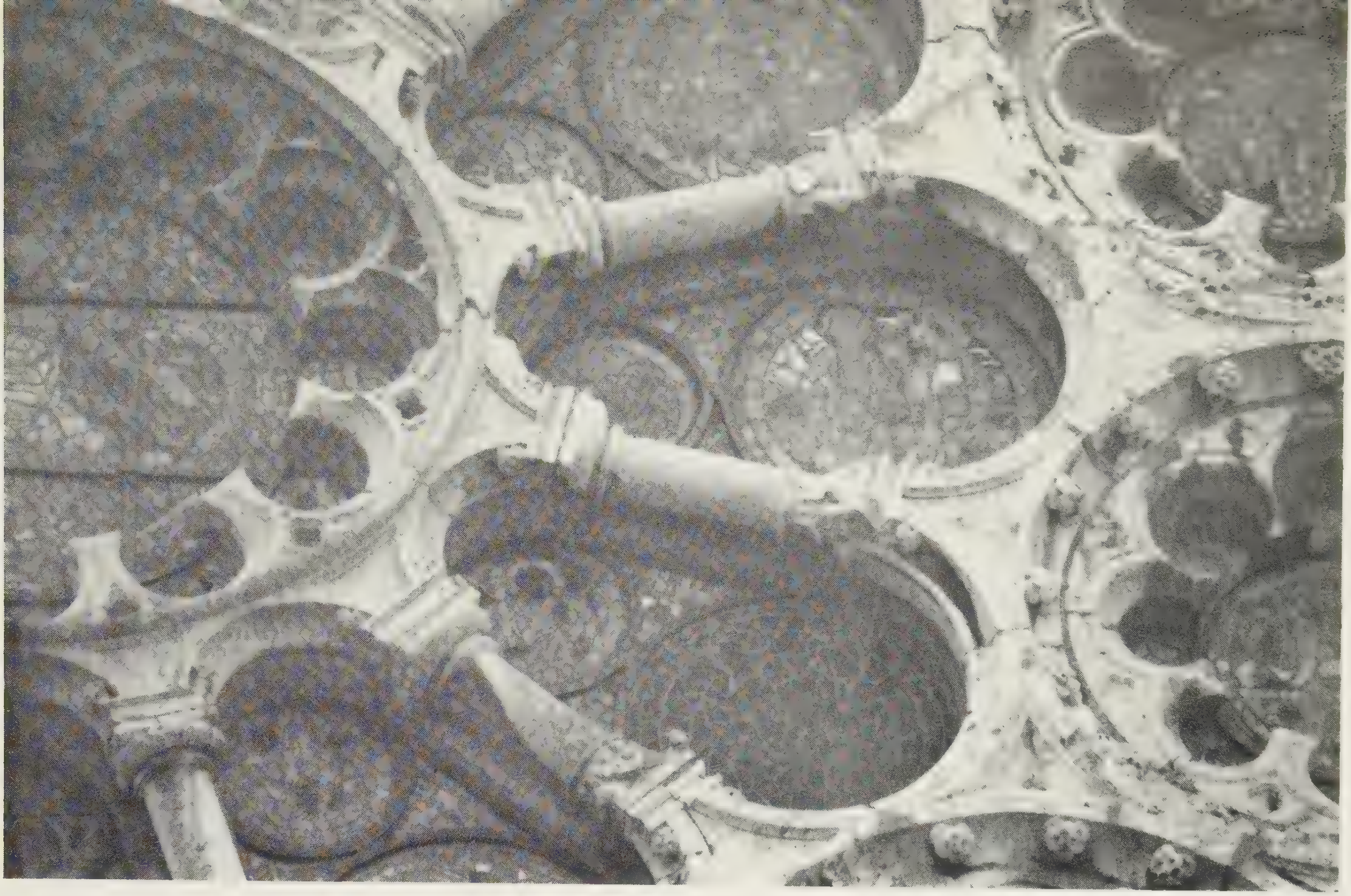


PHOTO 499: A detail of the western rose showing the heavy columnar construction. Compare with the flyer spokes in the nave.

20. James, 1973(2). The geometry is complex and need not be repeated here. But it is based on the Roman Foot and the PM, uses interlocking figures and could only have been the work of Scarlet. Also
  a. The shafts in the rose and in the nave flyers have a height: diameter ratio of 3:1.
  b. The bases have the same groove under the torus as Scarlet always used - XVIII:49/d.
  c. He used round arches and four-foils, not pointed or 3-foils.
  d. The moulding framing the rose has been cut in the shape of Scarlet's corbel. In Laon, Mantes and elsewhere we find the master's own moulding surrounding their roses.
  e. The capitals in the rose are like those in the nave flyers - XVIII:53. Work of Scarlet -*Screw* and *Shelly,* Ruby-*Plane* and *Hats,* and Bronze-*Bustle.*

21. See n.20/e.

22. XIX:33/P.

23. XIX:33.

24. The framing circle of leaves has been cut from 37 stones, with two leaves per stone. This is a curious number, and not one which would have helped them to calculate the circumference from π. In James 1973(2) I wrote that "numbers had an intrinsic significance apart from the way they were assembled. The rose has 37 openings in it. Multiplied by three - the original foot unit - gives 111. From this comes 666 and also 888, which ancients assigned as the number, above all others, to represent 'Jesus the Comforter'. 37 is also a Prime." John Michel showed me that all of these numbers occur in the 6 x 6 Magic square, which in the middle ages was called the Square of the Sun. In this square the sum of each row is 111, the sum of each block of four is 74, the sum of all the numbers round the perimeter is 370, and the sum of all 36 numbers in the square is 666! The rose is in part a material expression of the properties of this square.

I continued "37 is a prime, and is the factor in a number of important Cabalistic numbers -111 which is the sum of 6 x 6 magic square, 666 which is the number of the Beast from the Book of Revelation, and 1480 which is a value in gematria of CHRIST - whose figure blessing his worshippers adorns the central circle. In confirmation the surrounding cornice of the rose contains 74 leaves carved from 37 stones. Again there are 192 glazed circles, excluding the central one with the figure of Christ - as we should for 192 is the number of Mary (half 192 spells BEATA VIRGO). Thus Mary the Mother, patron of the cathedral, enfolds her son at the centre of the vortex just as she supported him at the apex of the central lancet window directly beneath the rose. Also when you count the number of rosettes there are twice 192, or 384!" - a number which also appeared in Scarlet's overall length of the cathedral in VIII:73. Follow some of these numbers in Scarlet's labyrinth GEOM:XIX-A.

25. The Bronze sequence is in GEOM:IV-G. Variations on the theme of the west rose can be seen in two copies which survive. Villard de Honnecourt's sketch of the rose is one, but he modified it by placing the outer dozen circles over the centres of the lozenges instead of between them and over the columns in between, and by inserting an extra set of quatrefoils into the spaces so formed. The second copy is on the wall of St. Quentin. François Bucher showed this to me. The design is like Villard's except that there are eight cusps within each of the outer circles instead of his twelve, and the cusps are aligned radially instead of gravitationally as at Chartres. These two designs, both later than 1215, suggest that the Chartres west rose concept was being admired, refined and modified for some future use.

26. When I examined the original stones of the north and south roses which still lie in a tumbled heap in the WS tower, I came to the conclusion that their details accord with Rose. No pun was intended here: it is just a coincidence, I assure you, for I named this crew Rose three years before I began to suspect it may have been the rose-building Rose. Of course, one cannot be in the least bit dogmatic in comparing carving done in 1214 with that of 15 years later, but when I examined the original stones at close quarters I was constantly reminded of the leaves Rose had left earlier, rather than of the work of any other crew.

There were attenuated, drilled and ribbed leaves with serrated edges as in the S.w ε arches, drilled and undercut leaves covering berries as in the S.w pier caps, long fingered leaves of the north piers and lintels, and the scooped leaf of the small shafts under the S.c piers. They did not scatter themselves around the circles of the rose as we would expect from most teams, but alternated in regularly repeated sequences of berries and leaves as in his work of the south porch archivaults. See XVI:K3 & 10; XIV:38. Gangs may be *Clover* and *Cup, Bud* and *Bird.* The column bases have the same cut corners with the crease through its centre as Rose used - XIX:23. But, when it can be measured accurately the geometric analysis may help us to be more precise by showing us Rose's foot and pentagonal geometry within the rose.

So I tried placing the rose in campaign 'j'. That was fine. There were more of his bases surrounding the north towers with his wide corbel next to them, and so on. So if in 'j' he carved the south rose, he should have carved it in 'm' in the north. Here I came up against a problem. The analysis in the transepts depends on the dossiers from earlier work where the information is much surer, but in 'm' I found Rose and Ruby characteristics mixed up. After all if 'j' was Rose, then 'm' should be Rose too. But the master in 'm' carved the uppermost window of the ES tower just like the two below which were by Ruby-h, and so either this Rose was Ruby or vice versa.

The bases to the ES tower show that 'j' is Rose - n.6 - but as the choir cornice is Ruby-h -XIX:10 - as are many of the capitals in this zone - n.37 - I find the confusion unsolved. There is no way I could resolve it by 'creating' another team, for all the details used here matched the ones used by either Rose or Ruby, and are not like those of other masters. Perhaps the central stones of the rose had been carved at the quarry by a Rose gang and shipped to Chartres to be erected by Rose himself in the south, and by his cousin Ruby in the north. Why not? Two masters, each with their own gangs, sharing a common quarry and perhaps a number of geometric ideas, and perhaps a common inheritance, and standing in for one another as required.

When Rose won the competition he may have been free to come to Chartres to install his window, but when he was asked for a repeat version on the north he may have been busy elsewhere. So he asked his associate if he would take the stones he had cut and put them in. This suggests a somewhat more fluid arrangement between these two crews than the others, and is born out in earlier work. But their later campaigns suggest that the masters were moving closer together - IX:33. After 1211 gangs from one crew began to appear in the other, and after 1216 the melange becomes even closer - e.g. XIV:8/e and f.

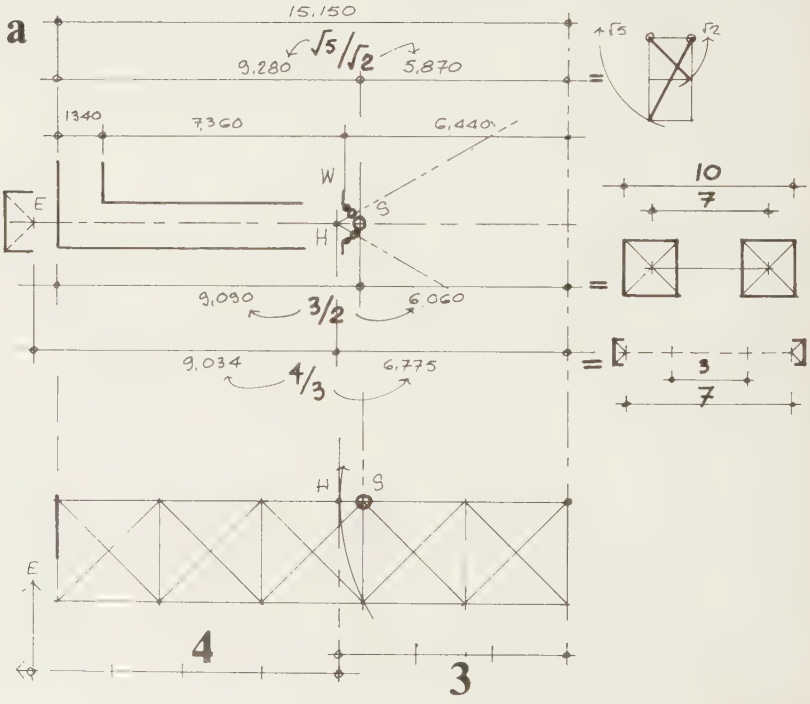
I called 'e' Rose because nearly every detail in his (except the flashing - XVII:14/m and some bases). Campaign 'h' I gave to Ruby mainly because of the geometry and the ES windows - n.2 - the choir cornice - XIX:10 and XIX:18 - and to keep the single and double treads consistent - n.9 - though he was using some Rose gangs - XIII:29/p,q; XIV:8 and XVIII:47 and 70. Campaign 'j' I gave to Rose from corbels, foot unit, carving gangs and column bases in the south rose. Campaign 'm' I gave to Ruby even though he installed the north rose because of the ES.176 window - n.2 - and XVIII:71 and n.28/g being his drains like those he installed in the SE tower.

The presence of Olive-n just after Ruby-m comes from many items; mainly in the other towers. The position of his work here suggests that he was called in to complete the installation of the north rose. Was it that Ruby could spare no more time from another job, and asked Olive to finish off the work he was contracted for, before calling back the local crew Green to complete the stonework around the top of the rose? Or did he have to leave while the carpenters were erecting the massive scaffolding that was needed to hold the stones of the rose in place before the arch and wall encasing it was built?

Geometry XX-A

The northern towers, Rose-j, 1229.

When Jade built the arch on the west side of the NW tower he created a proportion through the vault shafts **a** forming a simple ratio of 3:2 to the outer wall face A. Other masters had begun the same ratio on the other side, so it must have been a fairly common way of handling towers. The other relationships to the face of S and to the wall W are also shown. Following GEOM:XVIII-B I would not think that they are all primary, but remembering the number of masters who had something to do with this area I would not be surprised if some of these ratios had been put in by one master or another over the years. I have also shown the ratio to the epicentre E of the outside buttress, probably the work of Jade in his plinth course.



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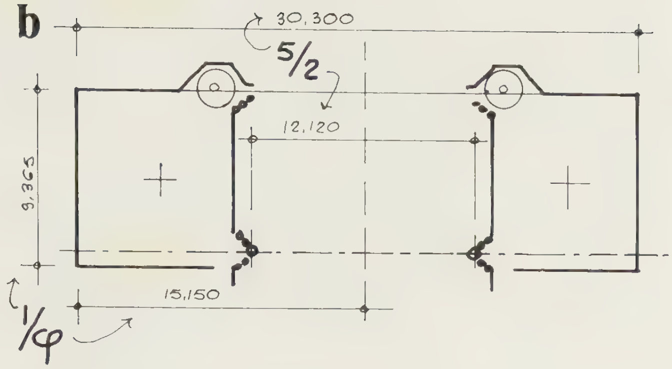


Notice how the system through S relates to the other through H - as 2: $\sqrt{5}$. This is shown at the bottom as a set of five squares locating S and A, expanded through $\sqrt{5}$ to locate H, the latter subdivided into three parts, and four of these then used to position E.

These ratios are linear in that they do not directly link up with the widths. Though this technique keeps the rectangles unrelated save in a fairly roundabout way, it made the job of setting out a lot easier. This figure could have been laid out on the scaffolding itself with no more than rods and string.

It should also be looked on as an intermediate stage between the master's preferred program in the towers, and the alien conditions he inherited. In later moves the master used the reductions in the plinth course to introduce homogeneity between the breadth and width. It is thus a two-stage technique, of firstly finding an acceptable relationship with the past, and then within that creating a more ideal present. The second step will, of course, come from some element in the first.

The width of the tower had been fixed in an earlier campaign in **b** as φ the overall depth. So one dimension of the tower stems from the shaft centres while the other stems from that. As the walls of the towers are angled to one another I had to try all the proportional combinations along all the sides and down the centre to find where the ratios worked on both sides. This showed that they had been measured down the axis of the pier and along the face of the clerestory wall, which are in fact the two most critical parts as far as the high vaults are concerned.

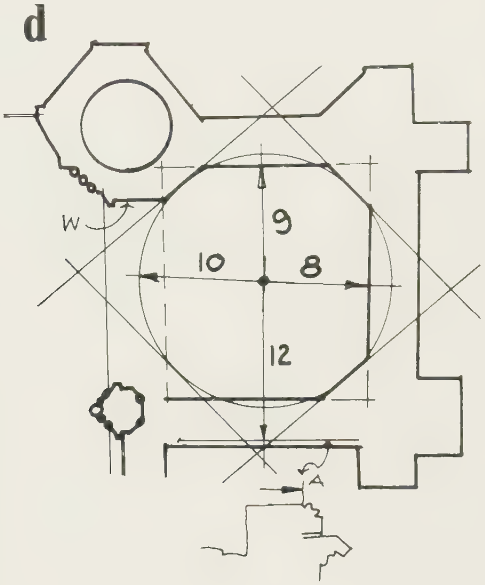
This was the situation Rose found on the job when he arrived in 1229. He then divided the width into seven parts to form the walls round the towers **c** and in the NE made the east wall the same thickness. The result is that the internal space relates as 8:9! Nice, considering the roundabout way it was obtained. In the NW the west wall was thickened to 1,720mm presumably because of the arch underneath it. In the NE a theoretical wall was placed alongside the clerestory wall, shown dotted, and the centre of the tower was located from that space. The same theoretical wall was placed in the NW, but as its west wall was thicker, its centre was closer to the interior.

This is apparent in the next act, where a circle was drawn from this centre **d**, and around that the diamond which fixed the splays in the corners of the towers. As this circle is a fifth larger than the internal depth of the tower, the eastern one is larger than the west. In the east, shown in **d**, the interior space and the circle within the splays form the sequence 8:9:10. One splay, with the side set true to the window W, forms the inside of the stair.

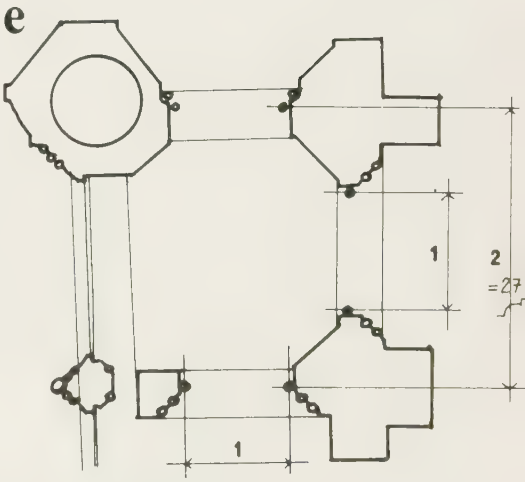
Having placed the inside walls Rose began the outer edge of the plinths under the tower shafts by expanding the internal width by one third, which continued the previous sequence into 8:9:10:12. This edge is marked A at the bottom of **d**.

In planning the shafts he and his successors Bronze and especially Green set the centres of the openings within the middle of their respective walls and not from the centre of the tower or of the clerestory window. The tower openings are therefore a decorative void within the solid buttresses and stairs. The set out seems to be to the centre of the shafts, and not to the wall behind them, for the distance between the outside shafts was usually fixed at half the distance across the towers to the adjoining shafts **e**. On the north there are only two sets of shafts, not three as on the other sides. Is this because Green increased the distance between the shafts to 27 feet, or because the splays on the flanking buttresses could not be cut into sufficiently to permit space for more shafts? Would other masters have cut back the splays? The opening seems to be one of convenience rather than of geometry. There are too many people working here for me to be certain.

d



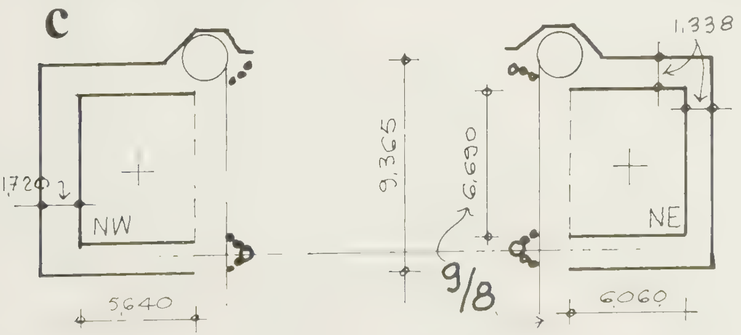
e

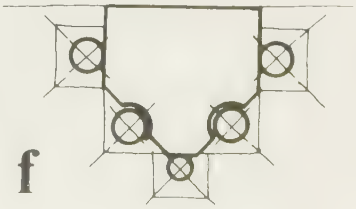


The central pier is the same in each opening, irrespective of the width **f**, except on the north where two flanking shafts have been omitted. Therefore the space between the shafts has no intrinsic significance, even though it is what is read by the eye. This pier is Green's. Compare the design criteria of these towers with those of the south.

...XIV-A,B,C,D/*...

c





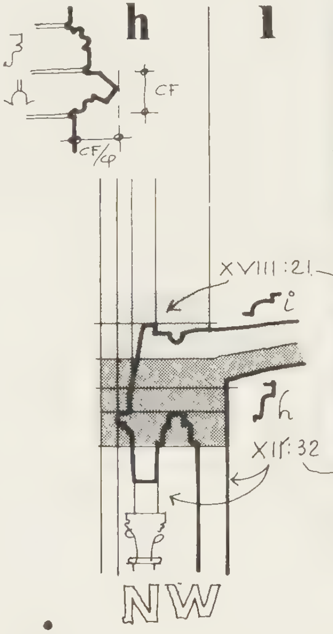
northern rose sits within an airy plane which ignores mass altogether. The expanse of the north compensates for the dimmer light while the firm circle of the south symbolically accentuates the orb of the sun. By yet another contrast the late afternoon sun always pours through the more brilliant reds and greens of the northern glass. The north-easterly inclination of the cathedral's axis ensures that the normally contradictory meanings of the north and the south sides would be disturbed so that for a while each day, even in winter, the radiant sun will illumine the Devil's side. One can feel its warmth, like a spiritual ray, driving away the northern cold and the pagan mists.

Most historians have felt that the north towers flanking the rose are older than the southern, for in isolation they have noted that its openings are less tall, less elongated, and that the base of the tower seems to begin much higher up the facade giving the north a squashed appearance.[27] However, this was due to a design decision which had nothing to do with 'styles'. The roofs of the aedicules inherited from the choir forced its base upwards. Once Jade-g had decided to carry the aedicules onto the northern side, later masters were compelled to raise the tower parapet to the level of their pointed roofs. Thus the lower parapet under the southern roofs has nothing to do with the Gothic "tendency to verticalism", but was simply a consequence of different facade treatments.[28]

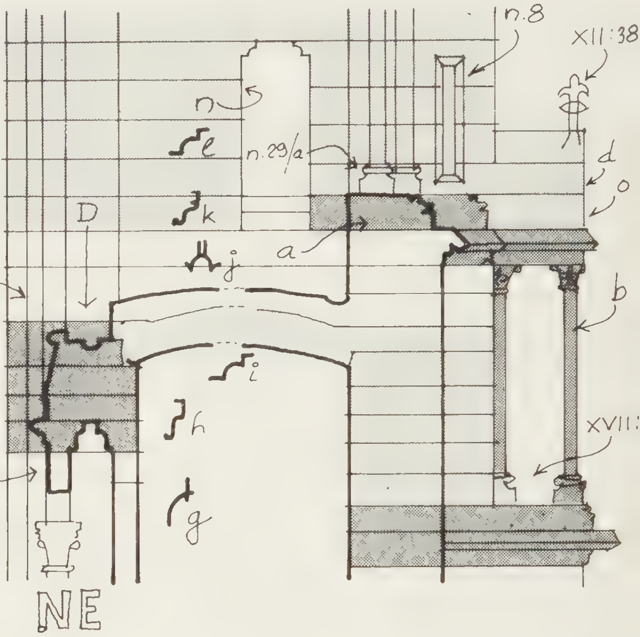
One of Green's windows breaks through the cornice over the north aedicules as if he had intended to carry the roof higher up and felt he still had room for another window before the roof began. From inside the stairs the joints pass through the window, and the change in stone finishes round the cornice can be followed up and back to the southern side of the stair.

On the other side of the towers the walkway passage round the clerestory windows enters the tower, where there are corbels by Rose and Bronze. Rose's have been cut with the bases under the shafts of the NE tower showing that the tower's plan is his.[29] He built the

h



i



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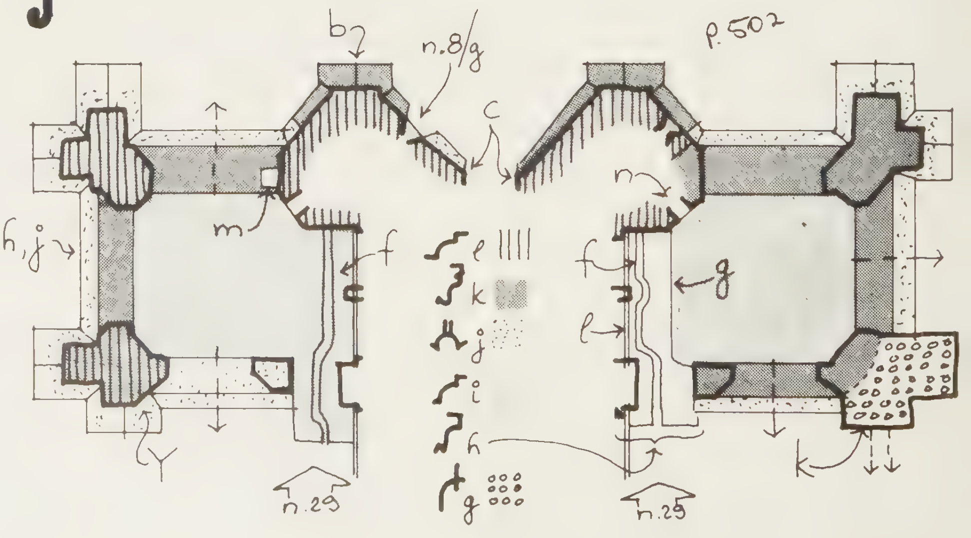

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[27] In fact the differences are not great. The NW is 300mm higher than the SW, the NE is 710mm higher than the SE, while the SW and the SE are at the same RL. See XVII:36 and text.

[28] *The bases and set out for the north towers.*
a. The cornice under the towers is the same on each side - this section **h** is through the NE tower looking to the west with the triforium and clerestory sill added on the left. The lower course is by Rose not unlike his in XVIII:7 with a height of one CF. There is a joint between the cornice and the plinth as one is set in from the other, and there is a change in plan shape. Changes shown in **i**. The drains are shown arrowed.
b. The cornice continues beyond the tower to form roofs over the aedicules. As drawn in XVII:36 the ones on the outer corners of the towers have a large central column surrounded by four smaller shafts just like those in the sanctuary. The capitals are Rose-*Scoop* and *Goose*. The aedicules against the stairs have a slender central shaft, and caps with carefully worked buds very like those in the nw. corner of the NW tower. Hence, ex n.37/c, they may be Bronze-k. The attribution of these courses is shown in **j**.
c. The junction between the cornice and the rose is different on each side, though the east was damaged. From the location of the joints I assume they are Rose and Bronze. The window NW.III breaks through the cornice - n.8 - which from 'b' is Bronze following Rose using the same foot unit and geometry as in XVIII:7.
d. The gable of the aedicule is built with flat roof stones framing a triangular infil **k**. All seven gables around the tower are the same, and not like those in the east. From 'b' the work of Bronze. Compare with XIII:47.
e. The plans of the aedicules are varied, see XVIII:36, 'b' and text.
f. The drain against the clerestory window D in the NE has the same shape as Ruby used

in the SE - XIII:54 and XIV:26. In the NW tower the drain is straight, and is by Green. They are drawn in **i**. Notice how Ruby continued to use Scarlet's roll-mould in the east - XVIII:21/l. These attributions follow from the order in which the stones were laid.

g. The roof over the NE room is 520mm above the drain D in **i**, and in the NW it is on the same level, because the pitch of the vaults under the roofs differs. The NE roof was finished by Rose-j, the NW by Green. Notice the different positions for the spouts, though all have the same 'octagonal' shape of Green. They are shown dotted in **j**.

h. On the west side of the NW tower an arch was built outside the wall which was begun after the cornices under the aedicules. It has a small splay along its edge, the work of Jade - XVII:14/u.

i. Under the apex of 'h' there is a corbel, the lower part of which has the same shape as some of the corbels supporting the north tower vaults by Green - n.37. He therefore placed it there to take the extra loads on the arch from the central pier of the tower. Done in 1229.

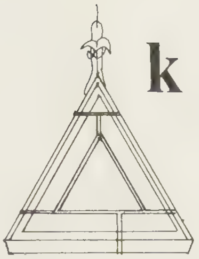
j. The start of the lancet arches under the rose ties in with the aedicules. Note the ledge half way up the wall by the eastern arch. The arch was placed by Ruby-m with the mullions. See 'o'.

k. In the se. corner of the NE tower follow the way the pier was continued up to support the choir flyer - XVII:27/1.

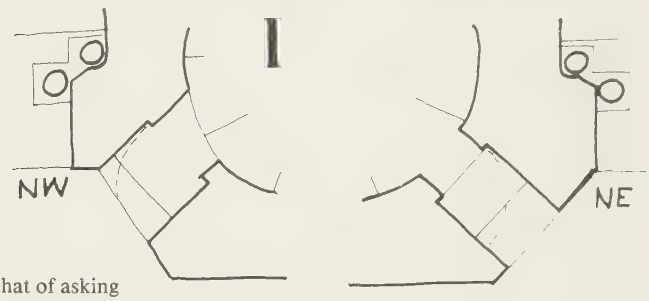
l. Two of the clerestory window mullions are set in from the inside wall face, rather than being flush with it as in all the others - SW.I and NE.III.

m. The nib next to the door shows where 'j' finished next to Bronze's plinth.

n. NE(cw) door is not the same as the other. On the west Green, the east Rose-j. The NW door was begun in the course below the cornice and is entirely by Green. They are drawn in **l**.



k



l

o. Only Bronze-k could have built the roofs over the aedicules caps A in **m**. In the next course lie Green's window W and over that the torus T and the starter for the lancet arches S. The shape of the arch begins square, and there was no provision for an oculus. As Green continued up to his corbel C over the door plus a further six or seven courses the lancet arches M, the oculi and the moulding over them were added in by Ruby-m. The moulding is typically his -XVIII:56 and X:44. The capitals under the central lancet arches are his too. Hence when Green was building the ten or so courses over Bronze he had left the space between the towers open and clear. I mentioned in the text that there may have been a competition for the rose, and that the winner may have had a hand in deciding the form of the work around it. Rose may have issued a drawing for the Chapter who may have showed it to the masters working up to that level, so that when Green began S he interpreted the ideas on the drawing in his own way. This example shows that the client's control was limited to that of asking his contractors to follow a general scheme without having possession of the templets for the details.

p. Standing over M are eight mullions with curved faces like the octagonal shafts in the rose itself. They are carved into M and are also the work of Ruby-m. The same section is used over the rose, either by Green-o copying the section underneath, or by Query-r in 1239 - see n.42/l. They sit on similar upstands carved into the drip course showing that drip and moulding were placed together. The exception is the second head on the west where the upstand is larger showing the joint position.

29. *Elevation of the passages into the towers from the clerestory walkway.*

Most items are covered by the note references on the drawing and by n.28. Also:

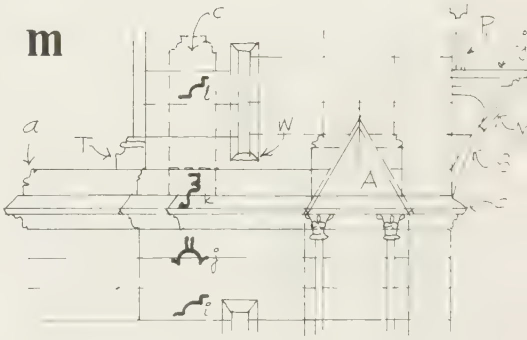
a. Some shaft bases Rose-j, others Green. The pier arrangement is essentially Rose's. In the sw. corner of the NW tower - Y in n.28/**j**. - the bases are buried in the wall, showing where the joint lies between Rose and Green.

b. Formaret bases over the clerestory sills Green-i - see where they are marked on the plan n.28.

c. NW corbels Bronze-k.

d. NE corbels Rose-j. They look similar, but follow different outlines. The outside one is clearly Rose, and is in the same course as the shaft bases in 'a'. The inside one is, like so many others, hacked about. It was once a Bronze, and was altered by Green. I tried to place Bronze before Rose, so that Rose could alter this corbel, but it would not work.

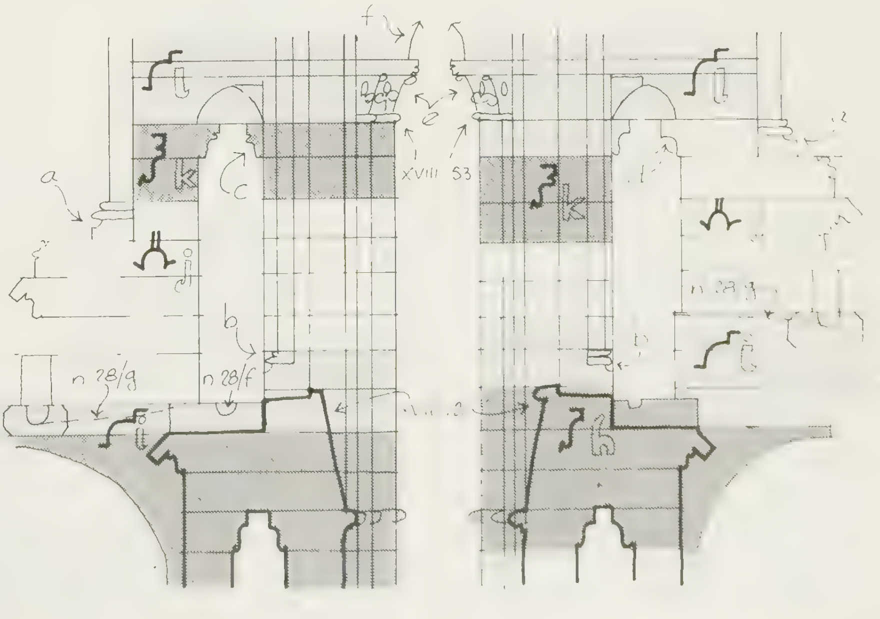
m

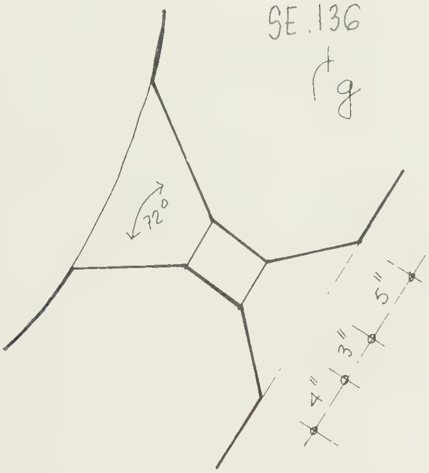


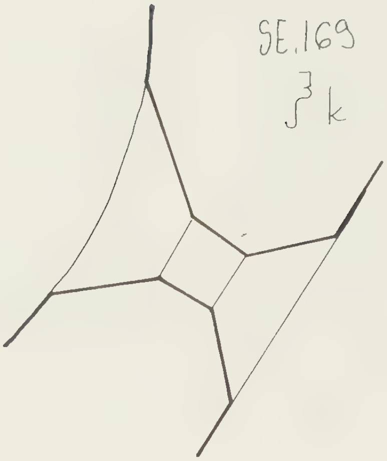
e. A pointed arch is incised into the lintel with a re-shaping of the buttress and with the springer caps, all by Green - XVIII:53. All caps were cut for circular shafts on the inside, even though the *en delit* shaft under it was octagonal.

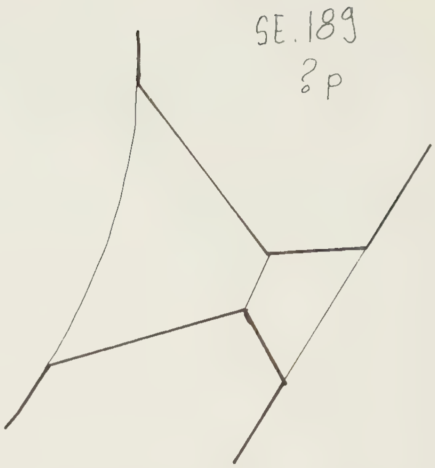
f. For *tas-de-charge* see XVIII:47.

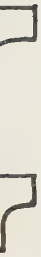
g. Notice how the plan of the pier changes with each change in masters. In GEOM:XX-A see how the joints are confirmed. Also see the alterations in the angles of the buttresses in the north outer corners of both towers, and in n.8 the change mentioned under window NE.117.











30. The two doors by Green open outwards, so the steps leading down to the tower roofs could be placed where they would not interrupt the opening of the door - a unique arrangement. From the coursing and the double treads they are the work of Green-i in the NW, and the inner side of the NE, with the outside side by Rose-j. I could not work out their geometry. Green's corbels look like Olive's, but with a return at the bottom. Both doors are the same height at 1 + φ times his 381mm foot. See plans n.28/l.

31. Unlike the northern stairs, few of these windows are the same.

SW.126 - The window is rather like Bronze's SW.93. The nearby joint lies just over the sill, and over the Bronze corbels to the clerestory door. See the changes in the angle of the wall over the door by SW.III clerestory window.

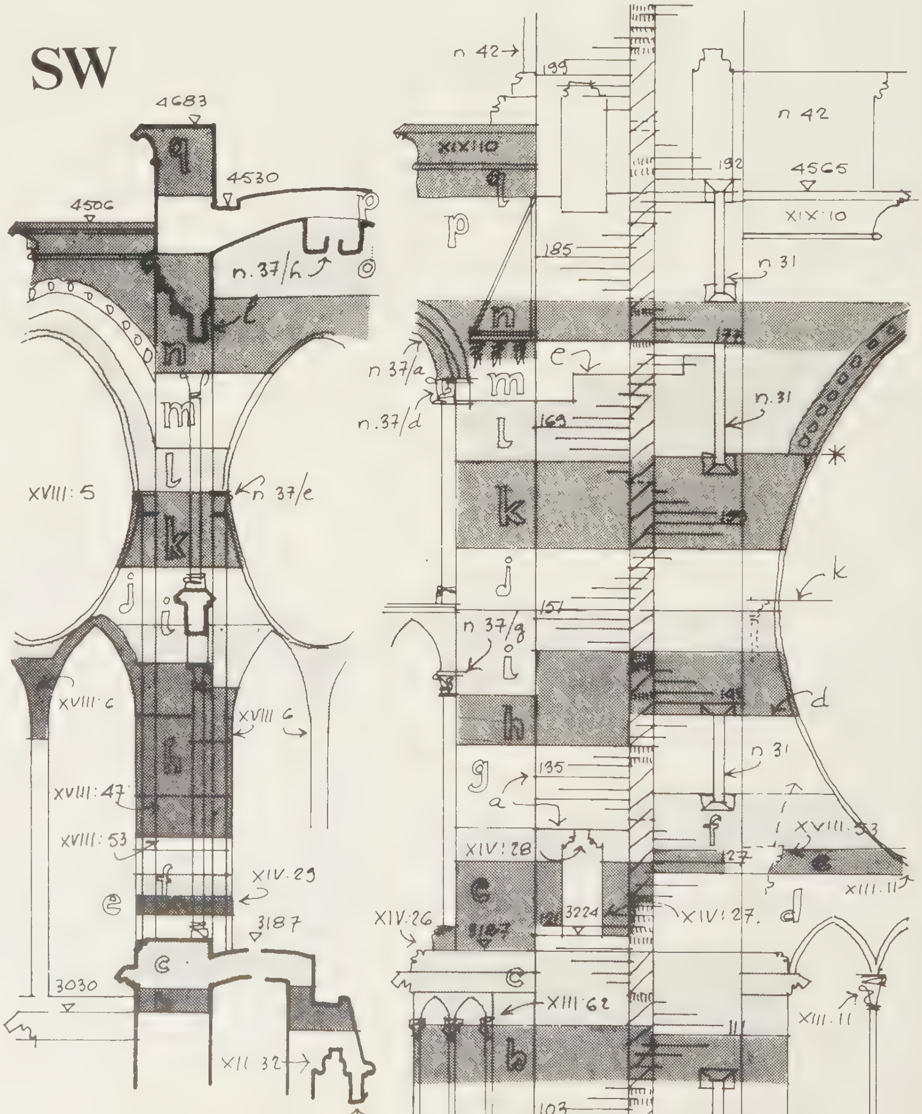
SW.158 - The sill is typical Bronze, but the plan changes in the next course to a shape closer to Green's in the north. The joint is that between campaigns 'k-l' on tread 162. The reason for placing the joint here is obvious from the outside, for the arch over the rose begins above the sill.

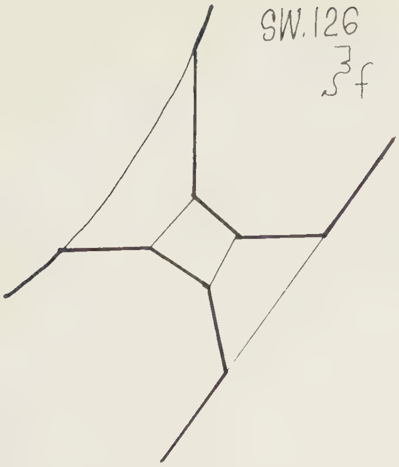
SW.175 - The window is similar to Scarlet's ES.69, EN.70 and SW.64. The larger part of the opening is on the inside as in the latter, and it seems to have been constructed from regular angled triangles. However the inside splays, and the whole shape of its opposite number SE.189, are closer to Cobalt's SW.55 and Ruby's ES.122. So whose is it? It could have been constructed from a larger EF than Ruby uses, which is born out in the plan for the nearby stair tower and the doors which used the Olympic foot of 308mm - n.42/b and d. Is it Ruby using a larger foot? or Scarlet, or a new contractor? From XVIII:5 the frames round the clerestory roses show it could not be Cobalt, Ruby, Olive or Green, so I have called this team Anon, for anonymous. He uses a type of rosette in his drip moulds not found before - n.34, which is why I finally concluded we were dealing with a new crew. See his style of geometry in GEOM:XX-A.

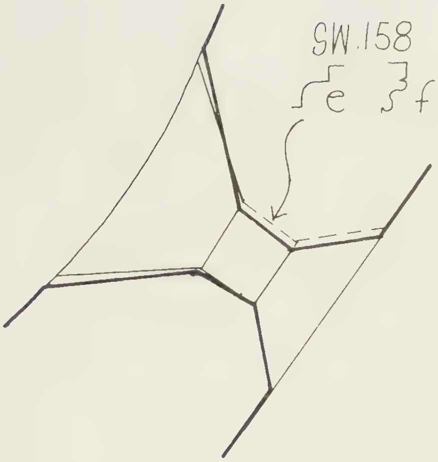
SE.136 - This window is by Jade-g. It is the only window by him on the job, without enough information to enable me to work it out. Below the sill there is a group of single treads from 131-7 matching a similar group in the other stair. The double tread 138-9 is built with the sill. Jade uses both singles and doubles.

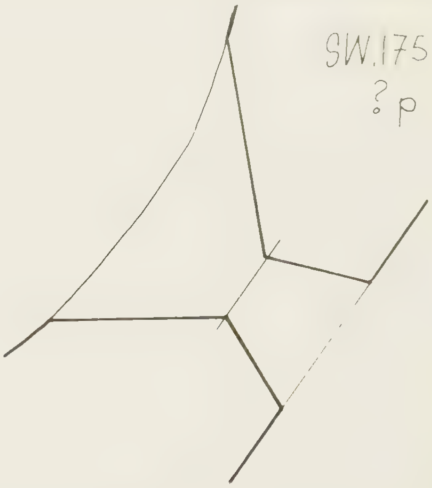
SE.169 - A typical Bronze window from campaign 'k'. He did enough courses around this window to fix its shape, unlike SW.158 where he had only been given time to begin the sill. The arch over the rose was begun with the sill. The joint with Green is fairly obvious for the newell is axed, and is as rough as in the north.

SE.189 - See discussion under SW.175. It was begun after the coping over the colonnettes surrounding the buttresses, and with the gallery cornice.



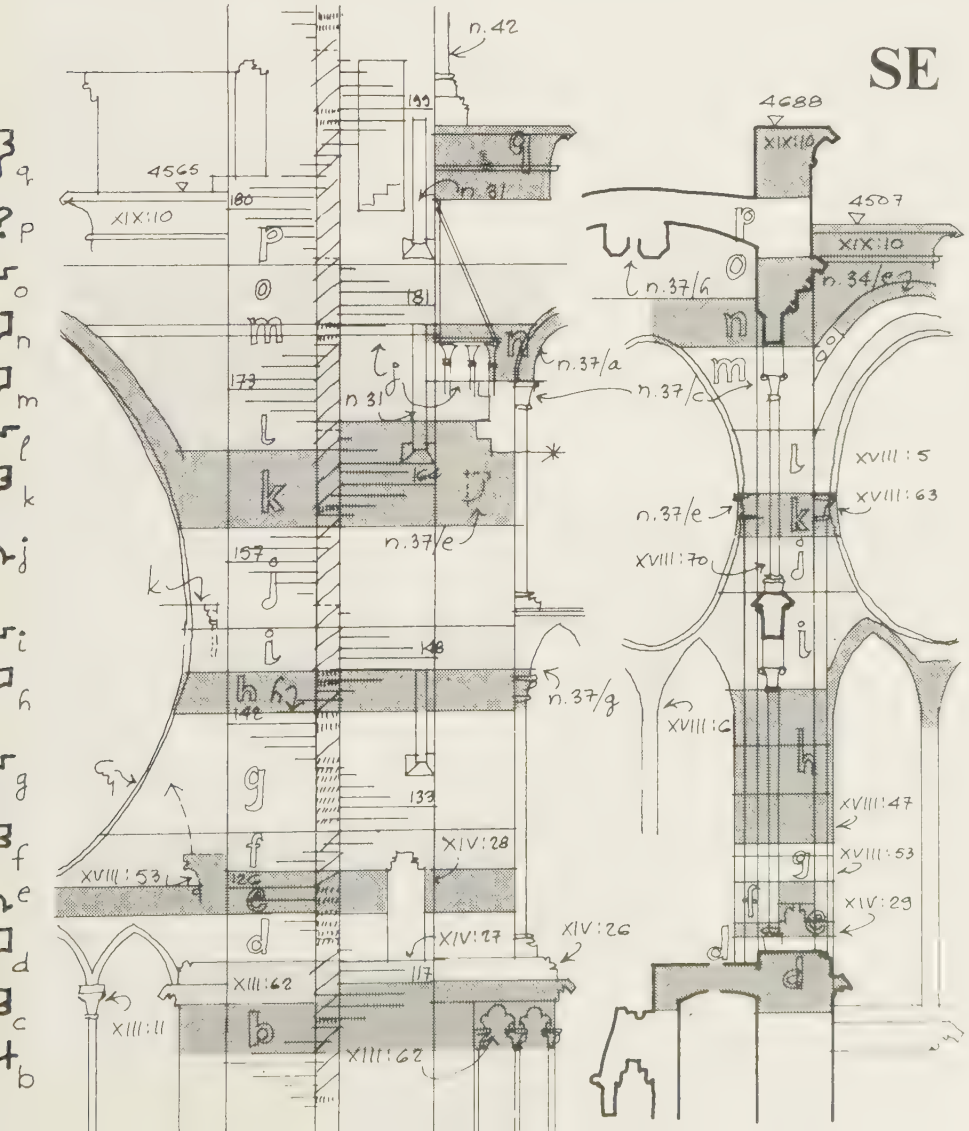






cornices and plinths to this tower in long continuous strips which are closer to the design of the south than to the east. If the cornice had been designed as a small roll-mould, as Scarlet had used in the apsidal towers, the base under the NW tower could have been set to the same height as the south instead of being so much higher.[30] Moving to the south side, and beginning there in the same way with the windows. I can identify each of the masters who carved them,[31] and though some are alongside the rose, they do not help to identify its creator. The joint which lies between Bronze's work and Green's can be seen in the two windows alongside the arch over the rose. It is marked on these elevations of the south facade, which have been arranged like the earlier ones of the north.[32]

They show that by 1232 the work on the south front



32. *Elevation of the south facade.*

a. Bronze corbel, with a joint over it - n.31/SW.126.
b. Joint could be either side of the double tread 135-6, and might include the next two singles.
c. The joint lies above the singles, perhaps rising to the head of SW.126, and on the inside includes the step to the lancet arch - XVIII:6.
d. The head of SW.126 was built with the installation of the rose, or after. The head is a typical Green with a 90mm slope.
e. SW.158 head was placed before Olive's capping over the colonnettes. The stone has a yellow colour below. Above the stones are grey.
f. The block of single treads from above Bronze SE(cw) door corbel.
g. The double tread 138-9 is built with the SE.136 sill.
h. Just below the head the holograph changes, alongside the double 143-4.
i. The head is level with the caps under the gussets, though the caps could have been butted on later.
j. Either at tread 172 or 176 the joint steps down to the east to well below the start of the tower arches, and does not include the cap over the colonnettes.
k. On the inside of the rose the centre is located with small capitals by Rose-*Curley*. They lie over the top of the clerestory lancets.
l. In the nw. pier of the SW tower the splays next to the shafts on the north face finish with a projection, and then a flat return in two successive courses. This is the joint between 'l-m-n'. Follow the broken coursing to the cornice at X in XIX:10.

was complete. The Bronze-Green sequence finishing the front is the same as the Bronze-Green pair who carved the start of the northern towers.[33] As with the porches many years before, the south had been given preference over the north. The Bishop's influence again? or was it only a problem of funds and the delays to the Job doorway? As there was less money in the kitty did they wish to complete one side before they became too enmeshed in the other? Once they had begun the erection of the rose it would have been too dangerous to have left its carefully carved units swaying in the air without an encasing structure. To have raised the stairs at the slow rate that was normal at that time would have risked damage from a heavy storm, or movement in the formwork. So they naturally sought to encase it as soon as possible, which is why the workers were ordered to concentrate on the south leaving the north to lag once more. By 1230 the north had been left some 10½ meters behind the south.

But once the south rose had been installed the rest of the facade seems to have slowed down once more, and the masters moved their sheds to the north. Not that work stopped altogether, it never did, but Green did only a third as much in the south as he was doing in the mammoth campaigns on the other side. The arches over the south towers were begun by his successor, and their drip moulds with their staring crinkled heads, and with the beginning of the tower vaults were by Olive-n in 1233. His drip moulds are unadorned, without the usual rosettes carved onto them. Nor are they the only plain ones: there are others in the north and in scattered patches in the transepts.

I say scattered as they are laid in short lengths above or between more normal sections which have rosettes in them. They have provided one of the more important sets of clues in the roof zone. From the north you can see that the plain team worked on the job at least twice, and from the south that the master who laid the beautifully finished masonry capping the colonnettes was also responsible for the plain drips.[34]

Between and under the drips in the towers there are projecting heads. We cannot place too much reliance on them, for the carvers seem to have been given more

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[33] See n.9 for the elevations. Green's large campaign in the north begins at this point. The few windows built into the south stairs shows how little he had to do with this facade. In his work lower down in the south the evidence suggests that he did not insert his windows because he was not working at the right levels to begin them.

[34] All the drip moulds have the same type of rosettes except where marked. The standard rosette consists of four petals set within four larger ones. This I call a 4/4 pattern. However some in the north follow a sharper scheme of 8/4. None of these stones have been replaced, as may be seen from the photos in the Archives.

a. Rosettes are carved in with the heads, so the non-rosetted drips which lie immediately above them are by the next master.

b. As the 8/4 lie in the centre of the arch and after Green's head in the corner - n.35 - and as Green's heads round the rose are carved with the normal 4/4 rosettes, the 8/4 master comes after Green, and the non-team after that.

c. As the 4/4 lie in the centre of the arch with 8/4 on either side there is another team between the 8/4 and the 'nons'.

d. As some 'nons' are built before the 8/4 in the next bay, the 'non' crew came at least twice. So it cannot be Anon-p or Query-r. The joint lies on the north side of the pilaster.

e. As the south transept was more advanced than the north, these 'nons' are in the same campaign as 'd's.

f. Since the dossier shows that Bronze, Rose and Ruby have consistently cut the normal 4/4 rosettes, I gave the 'nons' to Olive and from the sequence of work I gave the 8/4 to Query.

g. On the inside of the east towers special mouldings were used to match the piers underneath.

h. The rosette pattern was largely responsible for my realizing that the roof over the first bays of the transept was built after Ruby had laid their vaults - XVIII:76/x.

[35] *The heads over the towers.*

RUBY-m, 1233

a. Very professional, squirming with delicate little hands pushing outwards.

b. Too damaged to be recognisable. From the disaster repairs.

OLIVE-n, 1234

c. Crinkly heads, more cut into than moulded, exaggerated in form just like his leaves -XII:32/III.b. SE-s replaced, but in style. The little grinning head in the se. corner is unplaceable.

GREEN-o, 1235-6

d. Broad face, staring eyes, saucer ears, hair in ridges. Ridges on some necks. A projecting jutty effect that might link these with the NW-w centre, and the EN-e centre. The window NW.179 was carved with one of these heads.

e. Juts out but replaced. General form of Green?

QUERY-r, 1239

f. An obviously linked group. Some carved with the rosettes on north side of the NE tower.

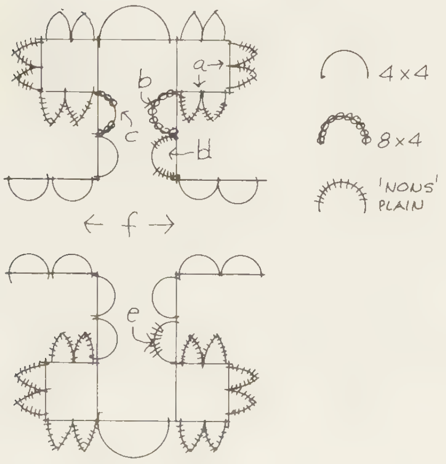
BRONZE-q, 1238

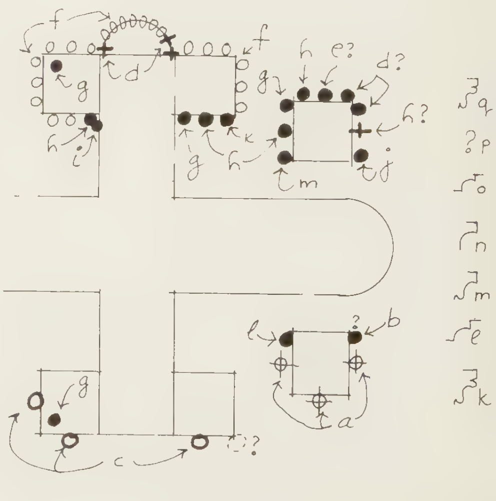
g. Full face, tongue out, staring eyes like his over E.I and II in XI:24.

h. Animal form, mouth cut with an indent in the top lip. Same sense of shape as others. EN-e could be Green.

i. Heads on the inside corners are placed with the arches over the openings, for they could not have been squeezed in later. Rosettes on one side of a head often squeezed in behind the head itself, e.g. NW-w, se. corner.

j. Three finely carved faces, one mouth type, all by one gang? From general shape and lidded eye same family as 'h'.





latitude to express themselves in their own way than in more routine details. They still seem to fall into a number of groups.[35] Working out from the head Green built with his window sill NW.179 the first group in the north facade must be his. Since one of them, a grinning devil with horns, protrudes below the buttons at 'g', then the other groups must have been laid afterwards. The second group includes some animals and, in the same stones, drips with rosettes. The third group suits the plain drip moulds, and this can best be studied by working outwards from the corner. However this does not help with the heads in the EN tower though two may be Green in 1231 and the rest are unmistakenly Bronze repeating the heads he had carved in the previous campaign.[36] The uppermost window in the tower EN.182 was built with these heads by Bronze, and is one of the windows discussed at the beginning of this chapter.

The same Bronze laid one, possibly two heads in the ES tower, but the remainder had to wait until Ruby could place them in 1232.[37] Normally one master would have followed straight after the other, but a catastrophe had

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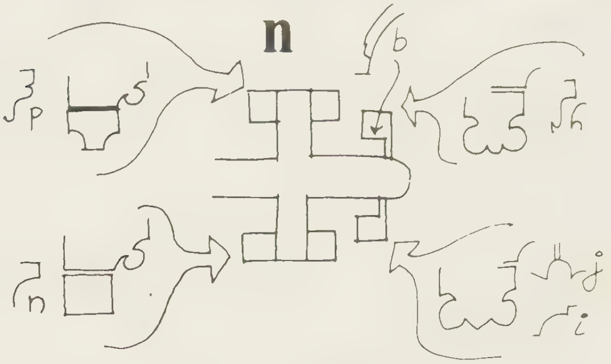

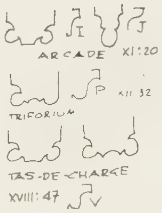

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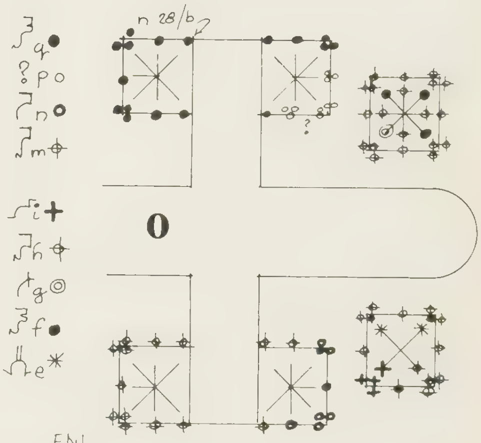

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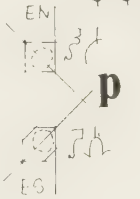

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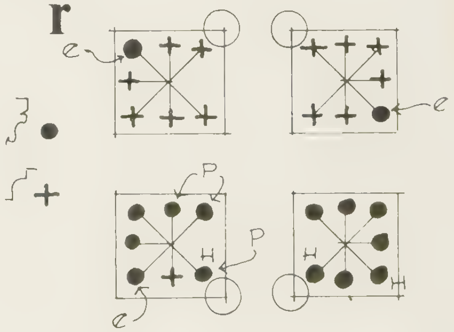

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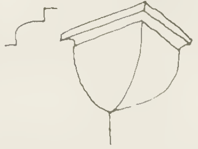

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k. Horse with drilled eyes does not relate to any other item, but at Gallardon the upper part of the flyers are decorated with heads. One is this horse, and another is 'g'. It is a varied group, and some of them seem related to 'h' and 'j'. On the unlikely assumption that both levels at Gallardon are by the same contractor, we might date the upper work there in the early 1240's.

l. Like those in the nave aisle at NE.IIIr in eyes, ear, and hair. Probably in campaign 'k'.

m. Slot mouth and whiskers not unlike Ruby's, but with none of his massive extremisms. From the order of work should be Bronze, but could be Anon-p.

[36] I worked out the sequence for the EN tower back from these heads and from the pattern of rosettes. It could have been finished earlier, but I would have had to insert another crew to adequately explain all the details.

[37] The final campaigns on the towers can be elaborated from the different arches and capitals around them.

a. The arches capping the piers of the towers vary. Four templets were used in six towers **n**. The other major arches are those in the arcade, the triforium and the high vaults which are drawn to the right. I tentatively attributed the EN to Ruby-h because of 'b', though the section is different to his earlier ones in the arcades. I attributed the ES arches to Rose, timing it in relation to the disaster in the formwork of the nearby vaults. There are similar ones at Laon that may be his. The arches over the north tower may be Bronze from the capitals under them, and the south Olive with his heads.

b. On the inner side of the apsidal towers the section of the lowest voussoire matches their neighbours, but the next courses in the ES continue the stepped section begun in the piers. In the EN the moulding finishes in a characteristic Ruby ending.

c. The capitals under the arches confirm these attributions **o**. The springing caps in the ES are bec **p** like those in the choir also by Ruby - XI:49. See also the Ruby caps in campaign 'e', in the EN tower south side, and then read n.26. The springing caps in the EN are square, possibly begun by Jade-g.

Among the Ruby-h caps in the south I identify *Hats* and *Circus,* and in the ES *Curley, Eyes, Hats, Lobby* and *Plasticine.* In the EN there is another group of *Circus, Crepe, Frills* and *Plane.* The Bronze gangs are *Brancher* and *Odrill* in the EN, and *Lobelia, Squid* and *Horn* in the northern towers. Olive's look like *Squelch.*

d. From the elevations in n.9 and 32 the ribs are as shown in **r**. The three shaded like his arches in **n**. For the apsidal bosses and ribs see n.6.

e. The corbels under the ribs of the transept towers are shown on **r**. The three shaded corbels are Bronze and the three marked 'e' have Bronze heads with big brows and cheeks - XI:24. Green's work usually has groups of leaves in large flowing shapes, thick, fluid, with a gashed rib growing from a common point, and bec **s**. In the south Bronze used simple corbels **t**, though a few have radially arranged leaves by *Horn* at H, and three project further from the wall at P and are bec **u**.

f. The coursing of the infilling between the arches where there are no heads is consistent with the methods the same teams used in the lancets - XVIII:6.

g. The gussets spanning between the piers of the transept towers are rectangular in the south, and arrised in the north finishing in the ball-mould. From the caps under the north gussets and from the bases over them they are by Green, though some may be the next crew Bronze-*Horn.* The caps under the south gussets are by Green in the south side of the SE, and Ruby-m *Eyes, Pawn, Curley, Lobby* and *Plasticine.* The source of these gussets is therefore Green - XIV:3. The gussets on the north are inserted between the piers, and are not built in as the work was proceeding. The Green leaves are equal to his corbel under the NW arch -n.28/i.

disturbed the work. It was not total, nor irreparable, but was nevertheless so perilous that a large part of the new work was in great danger. It seems that the formwork set up to support the vault over the ES tower had shifted and moved outwards. The movement was drastic. The inner piers which support the choir vaults were thrust aside some 250mm. Much more and they may have been pushed over altogether, crushing the roofs below and taking the flyers with them. The recently completed choir vaults would have been disturbed too, and may have come crashing down onto the beautiful wooden stalls just eight years after they had been finished. The collapse may have spread right across the choir since each bay of the vaulting buttressed the side thrusts from the next. The full consequences could have been too appalling to imagine.

The evidence for this collapse comes from the gap between the arches around the top of the tower, which are set plumb, and the piers which lean outwards. This is particularly noticeable over the central north pier, for the others were disguised somewhat, as all piers moved out to a similar extent. The staircase was large enough not to move. It restrained the action so that the adjoining piers shifted away from the stair, as well as outwards. The piers supporting the flyers were secured in the northerly direction and could therefore only move sideways. The total effect is as if the top of the tower had been hit with a hammer.[38]

The way in which the piers have shifted shows that it was the centering which gave way. Not completely, for that would have pushed the piers right over, but enough to disturb seven of the eight piers. Even though there are only four ribs, the middle piers were also pushed out showing that the centering for the cells, and perhaps for the perimeter arches, was involved too. Some of the timber may have been green, and left out in the weather

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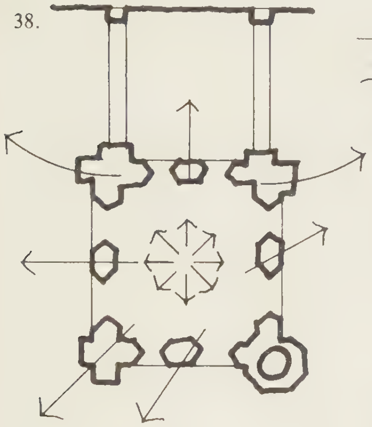

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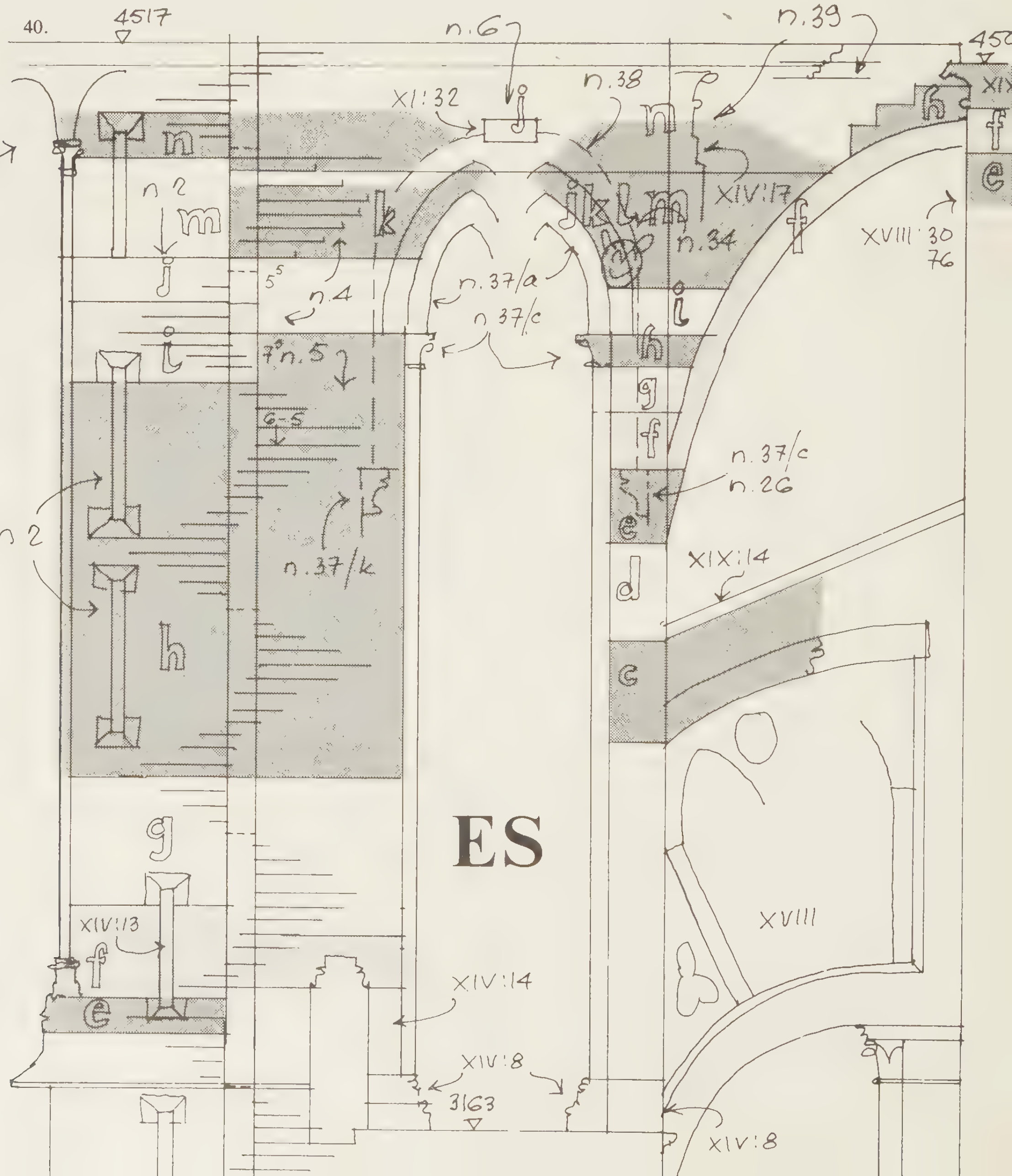

may have dried, allowing the wedges to drop out so that the middle of the formwork fell in, while the rest slipped down and outwards.

As the boss is by Rose, and as there is no sign of disturbance in the vault, the collapse must have occurred just before that, possibly during Green's campaign in 1228. Rose would have had to tie the top of the tower together using wooden beams firmly lashed at the corners, and within them rebuilt the formwork and begun the arches over them. Bronze would have continued with the arches and built the two heads on the northern side. At the same time he and his successor Green could have been reinforcing the course over the arches with wrought iron clamps to prevent any further movement. The restoration had to be careful, ingenious and inevitably slow. In the next year Ruby-m carved the remaining heads and the drip moulds, and in 1233 Olive finished off the tower with two characteristic capitals in the corners under the cornice.[39] This shows that it took four prudent years to repair and complete the damaged tower. Perhaps this is why no further attempt was made to continue with either of the eastern towers. The justifiable fears now instilled into the minds of the clergy may have begun the process of weaning them away from the original nine-tower concept for the cathedral. The history of the upper stage of the apsidal towers is described in these two drawings.[40]

At this time Olive was arching over the top of the two southern towers, and in the next campaign Green finished the vaults of the end bays of the transept.[41] The northern vaults were not finished for at least another eight years, but by the mid 1240's all the vaults could have been completed, and the glass to all the windows installed. It is clear in these areas that the programs are becoming smaller and smaller. From now on, save for a few courses laid from time to time on the half-finished gables and the

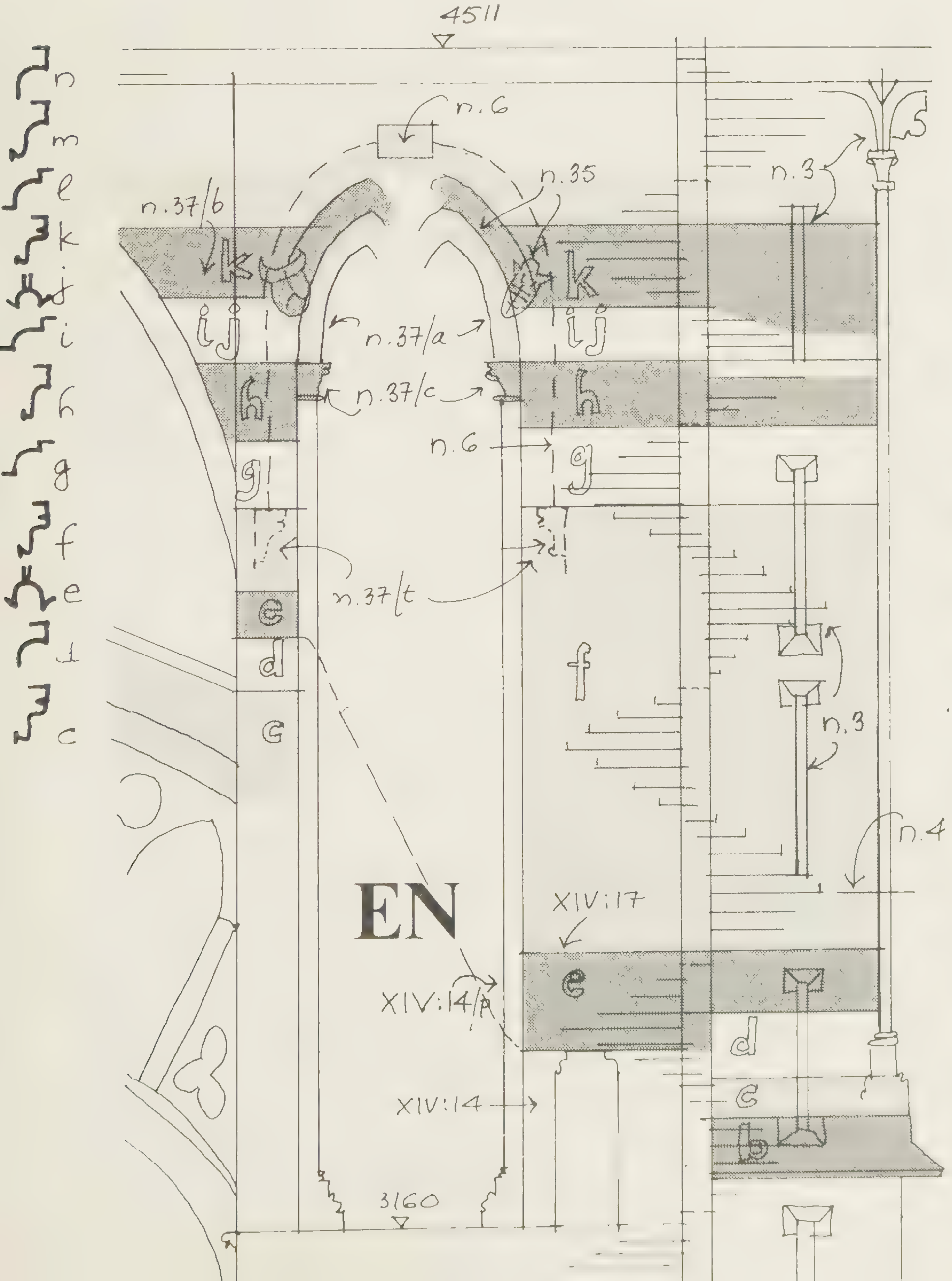

PHOTO 509: The vault over the ES tower. The boss is by Rose, with spurs.

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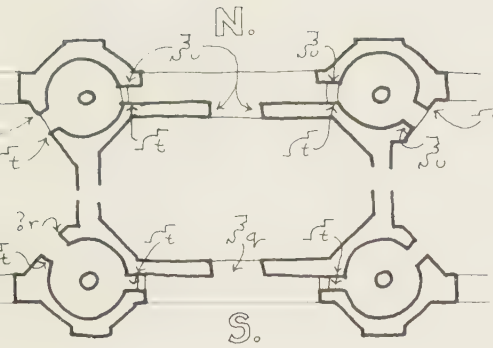
[39] Olive-*Squelch* and *Banana*. Above these capitals there is a pair of mouldings which cap the bridges to both towers and the cornice over the ES. They are the corbels of Cobalt-x and Sapphire-y in the later 1250's. Their identity is discussed in the next chapter. See top n.40/ES.

[40] On the left the diagrammatic elevations of the apsidal towers seen from the east.

[41] XIX:18.



42. *The top courses of the transepts.*
The drawings ignore the screen and the bulk of the outer wall. After Green built the walls round the north rose in 1236 the work began to slow down even more. There are another 18 distinguishable teams in the last few courses of the gables - as many as had been needed earlier to bring the entire cathedral from the ground to the level of the triforium. The drawings show the extent of the work from the top of the rose to the next pause after Bronze-u about 1242.

They begin where drawings 9 and 32 end. Once the southern rose had been finished Green-o raised the north to a similar height, and then the next six teams gradually brought each gable to the same level, which was enough to cover the ends of the roof over the last bays.

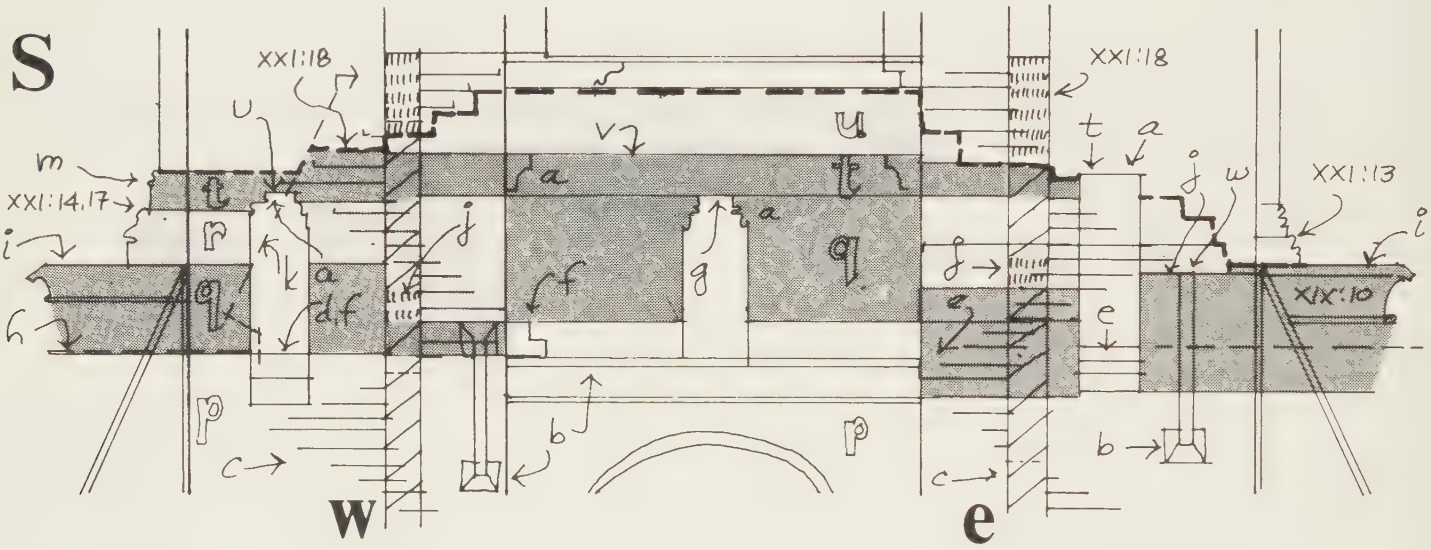
a. The corbels are shown in the plan. They are nearly all Bronze and Green. The Bronze belong to the earlier crew in the south, and are from a later campaign in the north. At A Green established a door height of 2,180mm as in the N(cw) doors - n.30. At B the corbels are Query-r on the east laid one course above Bronze's into the roof at C, followed by Green on the west side. Query's corbel is like a Red, but is very mutilated. Bronze at C is still after 40 years working his corbels to heights of √2: √3. The order of crews in the south is Bronze-Query-Green. In the north we have Green on the inside of D, and Bronze on the outside jamb with the bases under the screen. At E he is followed by Lemon, though the damaged corbel on the south side need not be Bronze - see 'u'. Combining the information from these two sets of corbels and inserting Olive's from the non-rosette drips - n.34 - the order becomes Bronze-Query-Olive-Green-Bronze.

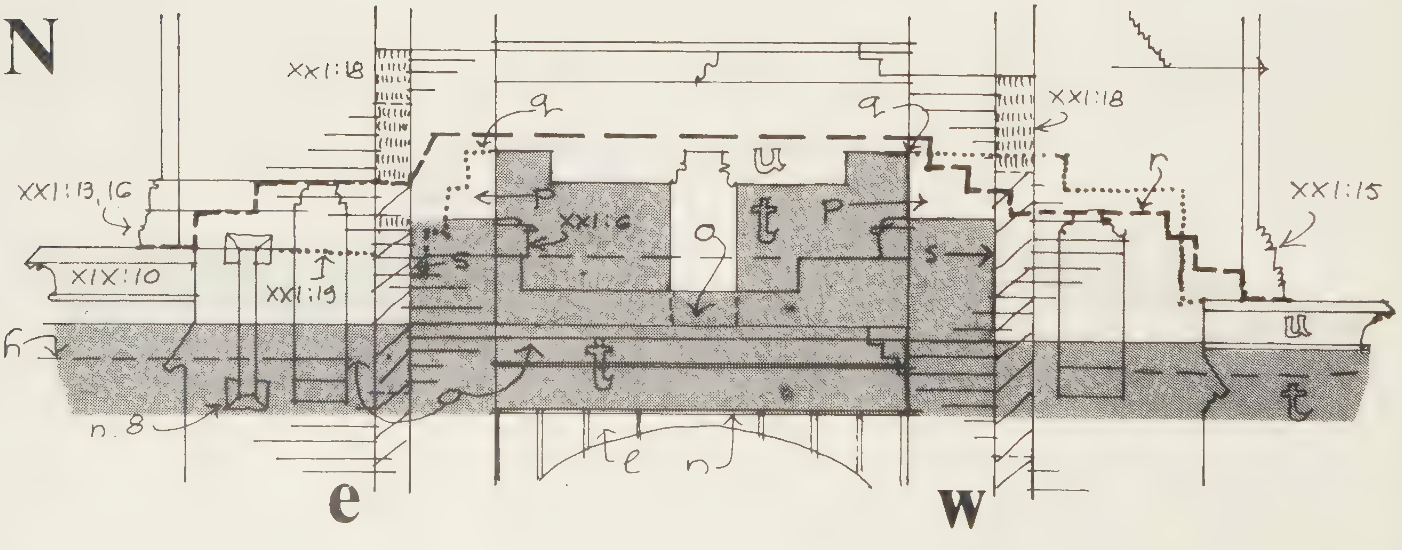
ANON-p, 1237

b. Began two slot windows and the walkway/cornice under the south gallery. See his foot unit in n.31 and GEOM:XX-B. Presumably set out the door from the gallery onto the roof.
c. Double treads.
d. The lobby to the SW-W door was built with this window. As the geometry for both doors, the window and the buttress are related this whole section was set out together. There is a joint just below the threshold of both doors. See GEOM:XX-B for a description of this level, shown in **v**.

BRONZE-q, 1238

e. The arrangement of the SE doors is not like the SW. Their openings are direct and the lobby: door opening is 650:530± which is either 5:4 or 2:φ drawn in **y**.
f. He altered the plans of both doors in the SW shown dotted in **v**. The west wall is





nascent WN tower, the site was dead.[42]

For two generations the town and its religious leaders had directed all their resources and enthusiasm to the building of the cathedral. What was the effect on the region of having so much money injected into the area for so long? Did they suffer from the same consequences of high capital inflow as we do? And what happened to a generation that had had time to become attuned to working on the building when the project finished and the funds stopped coming in? Was everyone satisfied to return to farming and the modest gains to the obtained from agriculture, or did the more adventurous emigrate to other building sites, or to the cities, leaving a sense of unfulfilment behind them?

The great sums which came into these small agricultural communities could be likened to the flow of tourist money into simple economies like Samoa or Bali. Barter and low cost exchange becomes less normal compared to the actual money that can be earned selling to or catering for the tourists, so the acquisition of money becomes more important than the regular seasonal life that existed before. To some extent the very act of building the cathedral helped to destroy the simpler mystic values which had created them. These values had embodied the highest ideals of the period, but in being realised in stone and mortar the fabric of medieval society may have been so modified that later generations gradually looked for new values and different forms of expression.

Unfinished, stunted of its promised towers, the cathedral still retained some of its scaffolding for many years to come. The last programs form a strange .and complex story without either grandeur or inspiration. The church no longer seemed to want to finish the great work: tired and more interested in other things, their attention had moved on.

pushed out to form regular 45° angles to the axis at P. This campaign includes at least one double tread, and the north side of the SW-E door with the splay in the wall S, and a jamb which is recessed into the wall instead of projecting from it.

g. Finished the door opening into the roof, and continued the wall up to the corbels.

h. The roof over the SW tower has a slope of 350mm to the west with a drain all round it. Other roofs rise to a central point, but are replacements.

i. Cornices seem to be his - XIX:10.

QUERY-r, 1239

j. Finished the outer jamb of the SW-E door with two single treads. He altered the shape once more, pushing it in on the south side shown dotted **v**. On the SE side two single treads lie just above the cornice.

k. Started the plan for the tower shafts with his corbel, and the flashing over the main roof shown dotted.

l. On the north continued the open grille with niches for statues which had been begun on the underside of the rose. The rose is thus framed within a square block of tracery. As the design is identical to the work Ruby built in 1233 I am tempted to identify Query with Ruby. He used singles too, but few other details are Ruby's. The corbel over the SW-W door could be his, but is ambiguous.

OLIVE-s, 1240

m. His only work in the south seems to be the torus over 'k'.

n. The moulding over the rose is the same as around the south rose - XIII:11/**b** and under the south internal gallery. Who then did the angels over the north rose and their canopies? Query? The towers at Blois may tell us.

GREEN-t, 1241.

o. Laid down the north cornice, the double treads and the door plans. Work was continued more steadily on this side. The plan of the door in **z** shows a contrapuntal use of 1:3, and after transforming the 3 into the side of a √3 triangle, proceeded through the circle to 2: √3. The north face of the gable wall was set along a stringline resting against the inside arc of the newel. He began the plinth to the gallery balustrade, with the heavy old-fashioned tori at each end. This has been drawn in front of the gable wall on the inner side of the gallery, slightly confusing the shading on the drawing. See XXI:6.

BRONZE-u, 1242

p. Continued the outside wall over Green's bases, including the splay up the corner of the wall and his corbels over the outer jamb of the gallery doors. For joints see XXI:4.

q. These splays alongside the doors finish above the corbel showing the next joint. It continues along the outside wall shown dotted, where it steps down to the top of the tower cornice, so that the bases for the next stage of the towers were not laid by him.

r. The Bronze corbel over NW-W could be with the lintel, but on the west it drops to the top of the parapet.

s. Double treads.

t. On the north outside corner of the SE stair there is a nib visible in PHOTO:522 which forms a 90° angle in the lower stones by Bronze, located at Z in **y**. Level with the top of the door jamb it changes to a 30° projection, and even this is eliminated in the next course Y. Follow the consequences after Bronze in the next chapter.

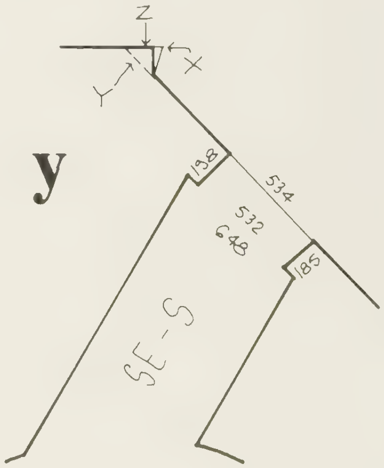
u. The lintel over the SW-W door has a splay over the opening which suits the broken edge of the corbel, showing it was cut for this place after the corbel had been broken.

v. There is a join over the Green corbel to SW-E, since the bend in the wall is straightened out. The lintel over this door seems to have been built much later with the screen by Sapphire-x in 1250.

w. Over the head of the SE.169 window examine the changes to the squinch at the top of the coping and the other changes to the shape of the south face of the buttress to follow the many joints here.

x. No more work is done on these gables for a while. The next two teams work on the bases to the shafts of the towers, but it will be about eight years [five - XXI:1] before Sapphire does any work on the gable turrets and the screen over the front of the gallery. This break is shown dashed. During these years this section may have been covered with a hip roof pitched out from the main roof - XXI:8.

y



z

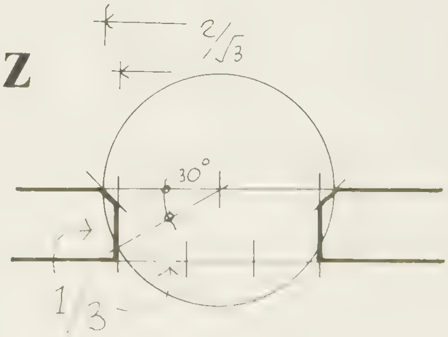
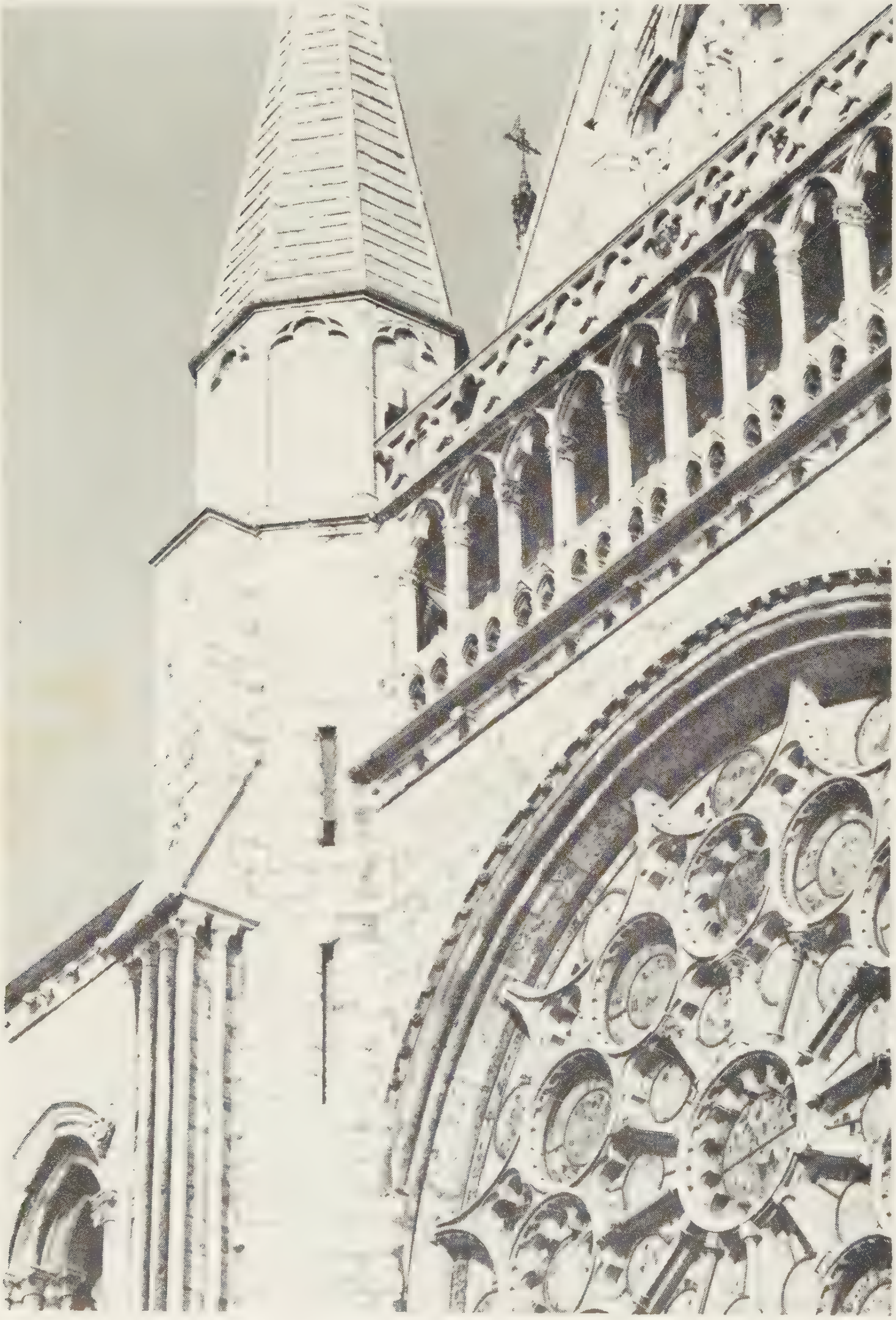


PHOTO 512: The turret and gallery terminating the SW staircase and encasing the rose window. The balustrade over the gallery between the turrets is recent. See how the colonnettes were finished off, and were not continued into the towers.



Geometry XX-B

The SW towers and doors, Anon-p, 1237

The outline of the doors and their treads show that the first plan for this section was not like the present. To the east the shape of the lobby was changed utterly, while in the west the outer wall was moved to the south. Once the square and diamond around the tower had been drawn the exact location of the earlier wall A could be deduced from the SW-S treads, and the points where C and D occurred on the circle H. In confirmation the axis through C then lay flush with the face of the gallery wall F, the thickness of the western wall was 1,230mm or four feet at 307.6mm, the lengths of the splays LD and DF are both 3,075mm seeming to confirm this foot unit, and the two circles have the same diameter.

These two circles are marked K and H. They do not originate from the same centres. The centre of circle H is J and lies on the line from the epicentre E to the centre of the inside wall at mid-bay B. The centre of the other circle K lies 160mm away at G, which is on the axis from E through N on the inner face of the newel.

The diamond was drawn within H. The outer walls were determined from below. The inner sides were then misaligned so that the north corner lay on the arc H and the line from N through the centre of the wall X. This X lies on the side of the square within the circle H. Only two angles within this 'square' are at 90°, one pair being set true to the inside wall BX, and the other true to the outside wall.

See how most of the intersections of the square and the diamond coincides with the sides of the three walls. The centre lines of the two doors continue to meet the axis at its junction with the outer west wallface U and the inner eastern face V. UJ = JV! Thus the sides of the lobbies are inclined to 'clear' the walls opposite them, or as negative spaces they are counterpoised to the solids of the walls opposite. A neat contrapuntal play. The door widths are two of his feet and their lobbies 2′ 4″.

Notice the 'feelingness' of these relationships. They are not part of a geometric process, but like a series of checks and balances - a process of adaptation.

Yet this buttress contains the essential elements of the geometry of this period -squares and diamonds set within circles, each circle with its own centre and the sides of the square and diamond deflected to accommodate themselves to surrounding conditions. Where possible the impinging walls are made to coincide with the intersections of these adjusted figures, and the penetrations are arranged to suit the master's feelings for the harmony and balance of the whole.

In the next campaign Bronze made his tower wall 1,340 thick, which is the same as the wall in the clerestory geometry in the previous interlude, and he inclined the angled wall at 45° to the tower.

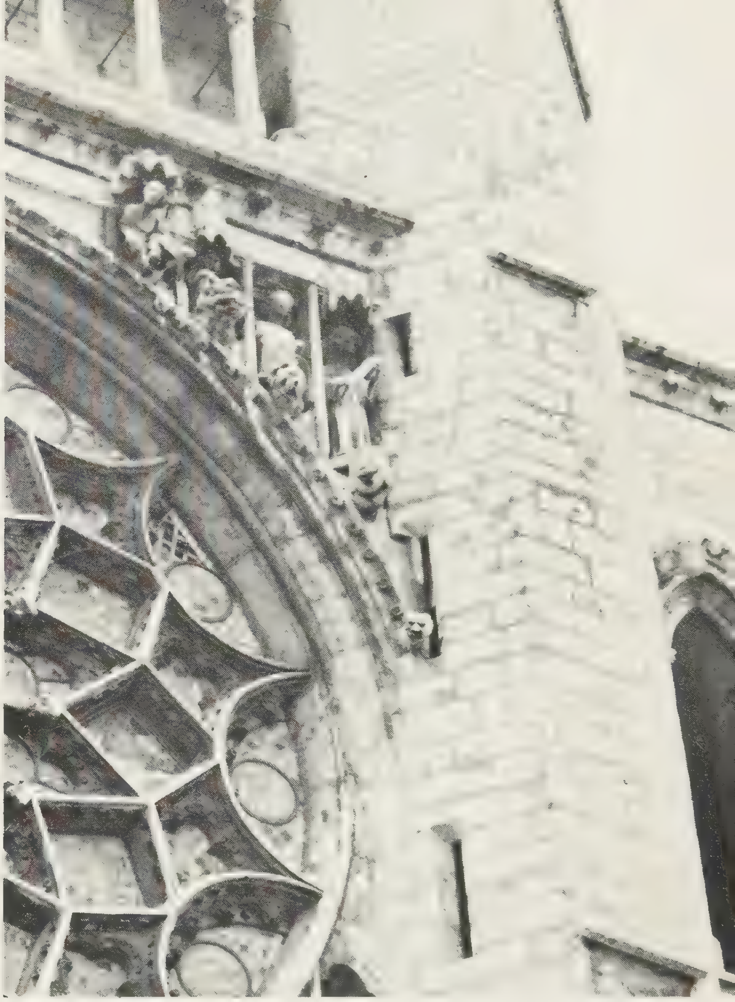
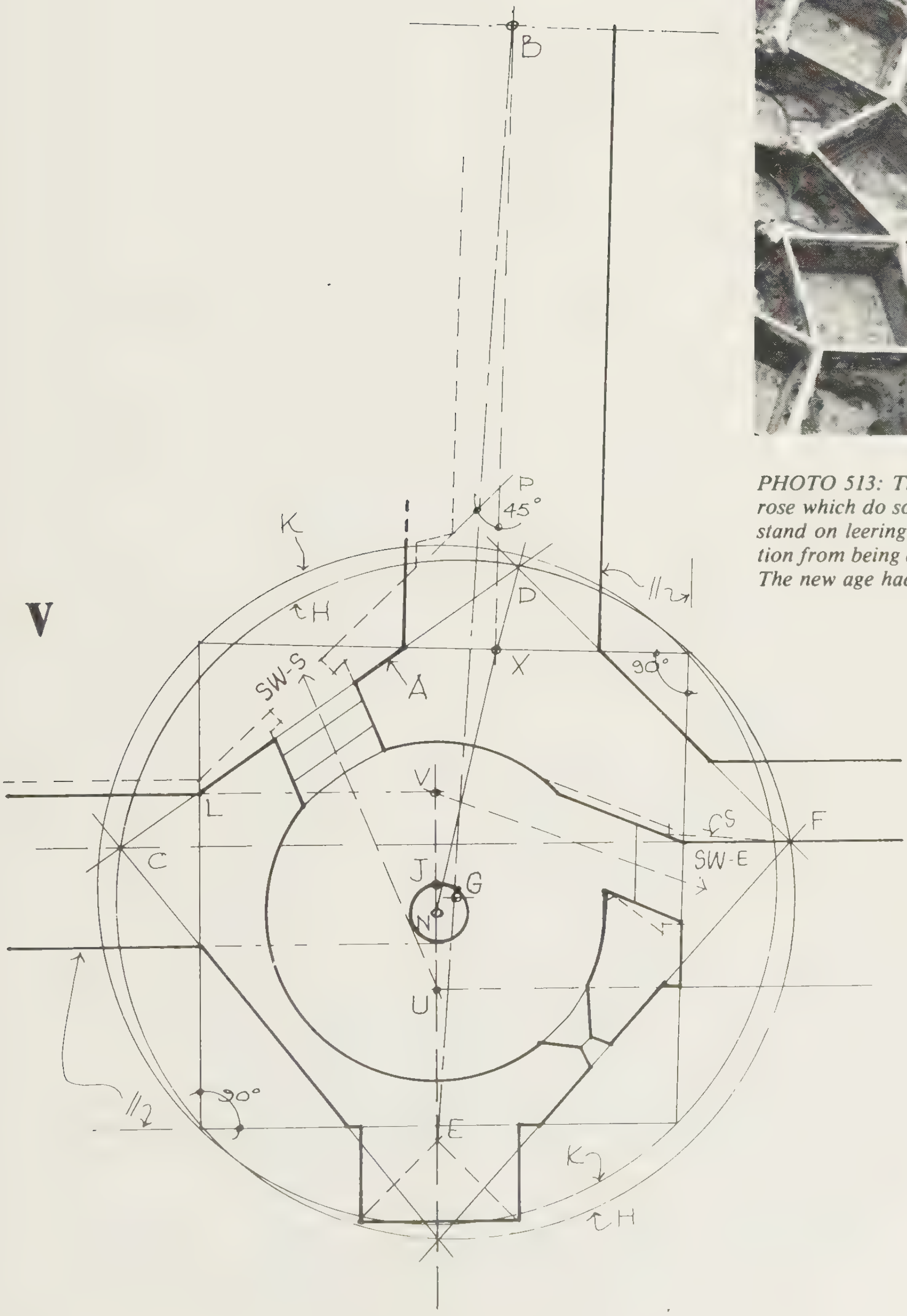


PHOTO 513: The top of the NW staircase with the recesses over the rose which do so much to lighten this facade. They contain angels who stand on leering and distorted projecting heads, and turned the elevation from being a wall with a rose in it as on the south, to being a panel. The new age had arrived.

V

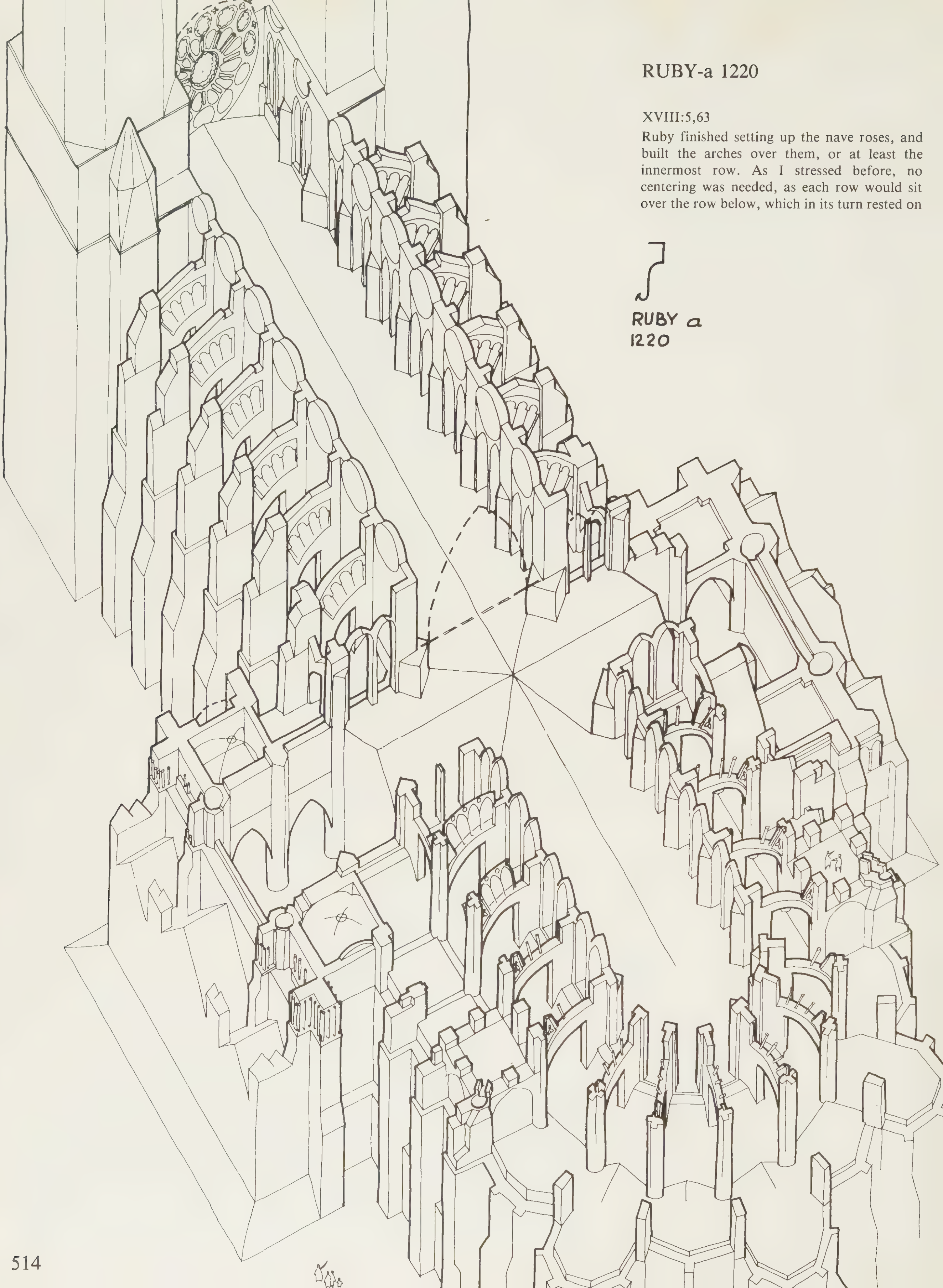


ISOMETRICS a-g
on the following pages show the completion of the vaults in the nave and in the choir between 1220 and 1226. These are the last of the isometrics, for the cathedral is now substantially complete. The final campaigns to the transepts and the three gables, described in the following chapters, are much smaller than any of the others. Fund raising and the enthusiasm which sustained it was on the wane.

RUBY-a 1220

XVIII:5,63

Ruby finished setting up the nave roses, and built the arches over them, or at least the innermost row. As I stressed before, no centering was needed, as each row would sit over the row below, which in its turn rested on



XVIII:49,76 the plates of the rose. After the arches were
XVIII:63 begun the bases for the attached wall shafts
could be butted up to them. As there was no
XIX intention at this time to build the third row of
flyers a pinnacle of some sort was still intended
on top of the buttresses, as can be seen in the
crocket over the east face of the WS.I.

XVIII:49 So Ruby continued to build the plain section
of the buttresses above the outer watershed,
XIX:14 and began the copings. The uppermost part of
the coping was left out - a better place to
support longitudinal scaffolding would be
hard to find, placed on the course under the
coping against the face of the wall.

XVIII:57,64 Ruby finished the spokes and arches in the
first bay. At the western end he began filling in
between the clerestory wall and the older
XVIII:34 towers, forming a platform for a room
supported on three rows of his corbels. He
probably erected the last stones of the western
rose as he probably completed the arch over it.
These plates, with all the surrounding
acanthus leaves, were precut, as their carving
and the corbel-shaped moulding on the inside,
is the same all round.

XVIII:6,76 He completed all the choir lancets, and some
in the transepts. In this and the previous
campaign there had been an interesting
development in the western transept bays -
XVIII:57 Cobalt had capped the inner spokes, and
XVIII:64,65 Ruby, at least on the south had set up the
lancets and over Cobalt's spokes had begun
the inner half of the arch, projecting it over the
as yet unerected other spokes. Over that he
laid even more courses, and more would be
laid in the next campaign. This made the pier
into a weighty pinnacle, loading it down.

The reason for the sudden activity in these
piers is to be found inside. Now that the arches
over the clerestory roses had been started the
height for the nave walls could be exactly
determined. Thus the time had come for the
erection of the crossing arch, as the height of
XVIII:65-8 its crown was known. Why the crossing arch,
and not the others? Because, as later work
shows, the construction of the crossing with all
four arches and the massive walling over them,
was to be an important stabiliser at the centre
of the cathedral, a sort of lynch pin against
which the separate vaults in the four radiating
arms could be held firm.

XI:48 As in the aisle vaults, Ruby was a cautious
builder, and set a wooden tie 16 meters long
XVIII:53 across the nave to prevent the arch from
pushing out the crossing piers. Along with the
weighted transept bays this must have been
one of the most carefully restrained arches in
the cathedral. Perhaps not without reason, for
its span was also one of the largest ever
attempted.

XVIII:6,30,58,73 Around the choir he set up more spokes,
finished the gussets, and began the pointed
arches over them with their oculus, not unlike
earlier work in the sanctuary aisle windows.
XVIII:47 The choir *tas de charge* was now complete.

The isolated piers were now rising faster than
the piers of the apsidal towers, presumably
because they were smaller. The *en delit* shafts
XX:40 around the tower piers would have delayed
erection somewhat.

XIV:14,24 Ruby finished the door jambs onto the EN
tower, with his corbel, and probably began the
masonry of the piers above the torus, with the
XIV:16,17 rounded corners behind the shafts.

In the ES he did little more than a course
XIV:18 around the doors and the last of the tori over
XIV:8,21-23 the plinths, including some by a gang who had
earlier worked for Rose.

He also began the cornice in the north which
XIV:14,20 transformed the square around the stairs into
XIII:46,47 an octagon. The aedicules may have been
begun in this campaign with the diagonally
placed central shafts he had earlier used in the
north porch piers. With it he would have laid
the lowest courses of the outer flyer arch. The
rest could be continued as soon as the inner
flyers were a few courses higher at a level to
receive them.

XII:32 Under the SE tower he finished the corbels
XIII:54,56 over the triforium passage, the window sill
XIV:29 over that and the drain alongside the sill.
XIII:17,18 Around the outside his work was two courses
lower, to just below the colonnette arches.
Inside the SE room he laid the arches over the
XIII:3,15 south window, and finished the cells of the
vault. The stairs were a little retarded, and his
XIII:51 work can be followed in the single treads,
which were at this time quite a distinguishing
mark. He would have been installing some of
XIII:61 the colonnettes.

In the SW room he built the ribs, and the boss
XIII:53 for the vault, and continued a few courses
XII:32 around the walls, with the corbels over the
triforium passage.

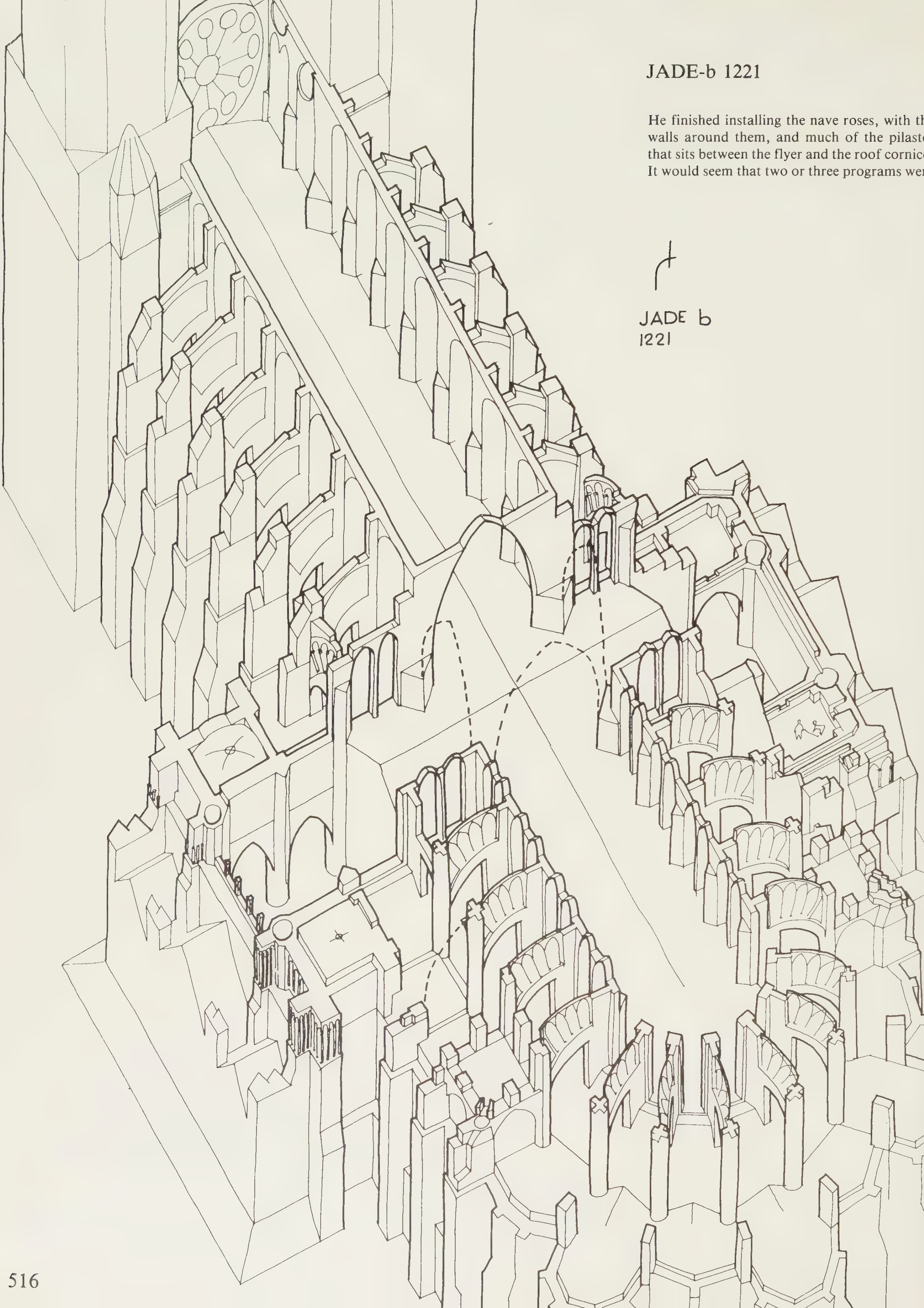
XV:41 In the north he began the gallery, the doors
XII:10 onto it, and the solid railing on the interior. He
XVII:14,15,22 set out both tower rooms, at least on the
G:XVII-A inside, and the first plinths under the NW.III
XVII:10 triforium arcade. However, as the exterior
cornice was a couple of courses above the
interior floor level, he was unable to locate any
of the outside walls. Though he did one block
XII:6 of the NE cornice, he was unable to impose a
colonnetted solution on this side as he had in
the south.

XVI:38 Ruby completed the gables over the two side
porches, with the gutters between them and
their spouts. Thus, save for the upper part of
the central gable, the north porches were
complete. He made no provision for
supporting the shafts of the arcades over his
XVII:3 part of the gables, and so presumably was not
interested in extending this idea across the
transept, though he may still have envisaged
smaller ones over each pier.

XVI:40 The *jubé* may have been completed in this
campaign, and erected with the new wooden
choir stalls read for the clergy to occupy early
in the next year.

JADE-b 1221

He finished installing the nave roses, with the walls around them, and much of the pilaster that sits between the flyer and the roof cornice. It would seem that two or three programs were



XVIII:76 needed to erect the many separate stones of
each rose, for each had to be dowelled, and
then held in place with scaffolding while
waiting for the arch over that would finally
anchor them properly.

Notice that the uppermost stones of the coping
XVIII:49 have still not been laid, probably because the
stones below were still supporting the
scaffolding in front of the roses.

Though the easternmost bay of the nave was
not as advanced as the rest, the connections
XVIII:65-8 between it and the crossing arch were being
quickly erected. The crossing was beginning to
act its part as the anchor to the vaults.

As the next stage in the process the remaining
XVIII:57,64 three spokes in the W.I flyers were installed,
with the arches over them. With them went the
wall over to the coping, and the uppermost
XIV:13,14 part of the buttress which encases them.
XIX:13 This included the crocket at the top of SW.I
which was later removed when it was decided
to add the third row of flyers.

XVIII:67,76 I think that the choir and two transept crossing
arches were begun later than the nave as only
the latter has a tie. As the isometrics show, the
more advanced nature of the nave made it
easier to install this arch first, while the others
were dependent on the crossing pier on the east
being taken high enough to take their side
thrusts.

XVIII:30,58 In the east he probably set up the last of the
spokes, and arches over them, though I have
attributed the thick arch over that to Bronze in
the next campaign. Being designed as an infil
unit, more like bar tracery than the massive
spokes in the nave, it was possible to build the
clerestory wall to the top of the lancets
XVIII:6,58,73 without having to complete the spokes. This
was particularly useful in the transepts where
they did not have to repeat the complexities
necessitated on the west in order to get this pier
up and the lancets arched.

XIV:14 In the ES tower he laid a couple of courses
XX:40 around the door, and to some of the piers. He
XIII:47 could have set up many of the columns in the
aedicules, most of which seem to have been
carved by Ruby, and could have begun
XIV:20 forming up for the outer flyer arches. He
could not have begun these arches as the
fascias of the aedicule roof from which they
spring were not begun until the next campaign.

XIII:3,61,62 In the south he laid the roof slabs over the
eastern room discharging its rain water into
the drain alongside the clerestory window. He
completed these colonnettes and capped them
XX:32 with his characteristically ill-jointed three-
XIV:2,6,26 foil arches. On the north side he began the
cornice with the plinth and a base for a shaft
XIII:18,29 under the tower vault ribs. In this he was
G:XIV-C,E designing the southern towers similarly to
those in the east, with rib shafts. Bronze would
eliminate these altogether in the next year.

XIV:29 On the west he vaulted the room, placed his
own drain against the windows, and a pilaster
XIV:26/i to strengthen the pier of the tower nearest to
the clerestory. The analysis of the geometry he
G:XIV-C used in these towers showed that his foot unit
measured 280.4mm.

In the southern stairs he placed a number of
XIII:51 treads, nearly all of them doubles. Both
staircases now finished level with the top of the
roofs of their adjacent towers. The level head
XX:32 over the SE.104 window seems to have been
Jade's, while the splayed head on the east was
probably Bronze's.

Jade possibly began the mullions between the
southern lancets. They are the first at Chartres
XIII:11 with attached shafts, though not the earliest by
any means, as those in the Reims aisles would
have been begun before 1220.

XVIII:10,14 The northern rooms were now taking shape,
XII:10 while the plinths under the triforium arcade
XVII:15 were completed and the balustrade across the
XII:6,10 gallery. The cornice around the outside was
XVII:10,11 finished, with the plinths that located the
G:XVII-B external faces of the room walls, including the
doorways. Across the north projection of the
NE stair the plinths were left out, presumably
to allow the workers to gain access onto the
walkway.

This is the first indication that there was
XVIII:27 to be a second row of 'arcade' arches over the
XII:6 north porch, in the stubby octagonal columns
set under his cornice in the NW corner.

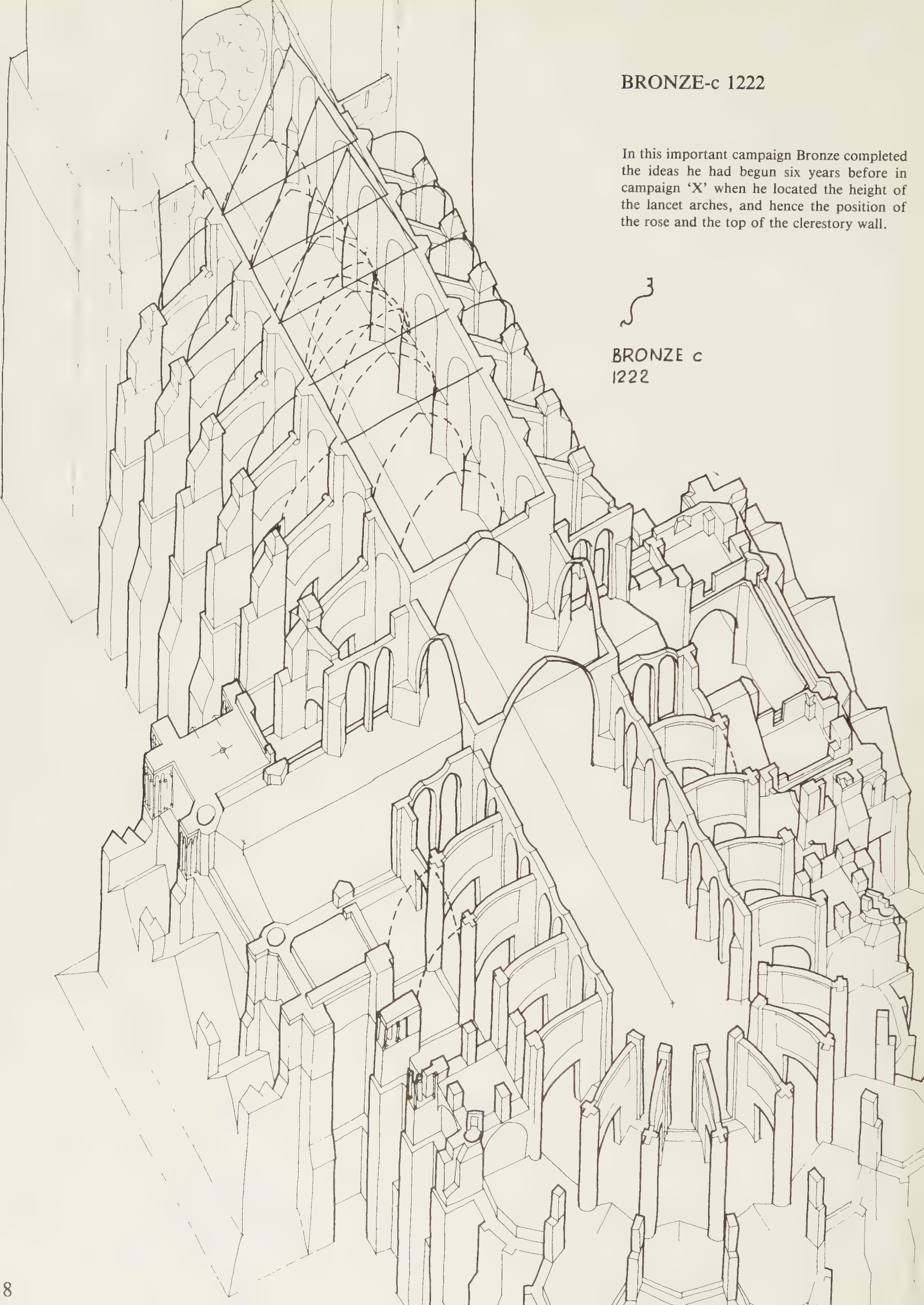
His geometry, as in the SE tower, is based on
diamonds and hexagons, adjusted as necessary
G:XVII-B,G:XVI-C to suit misalignments in axes or base walls.

The widths of the two buttresses terminating
XVII:36 the east-west axis were reduced, presumably
because, as later evidence suggests, they were
to be finished with aedicules like those he was
then working on in the sanctuary. Notice that
XVII:10 the outer stone at NE.III stands on its own,
unjoined to the other work, and is not joined
up for a while. This suggests that the external
corner blocks of both buttresses were placed
early in the campaign as setting out points,
from which other masonry would be located,
in much the same way as Scarlet-A had set out
the eastern corners of the E.IV buttresses
before the ajdoining walls, and Bronze-O laid
the SE corner triforium cornice above the level
of everything around it. This technique would
considerably simplify the problems of setting
out, as these blocks would help to accurately
locate all the work nearby.

This is Jade's first appearance on the site, and though the size of his campaign is below average, he confidently made his own decisions about how to design the clerestory stage of the SE tower, and the outside walls of the north transept. However, during this time most of his energy was directed to finishing work begun by others like the transept and choir flyers, the nave roses and the aedicules. There is nothing adventurous in this thinking, and his detailing tends to be clumsier than most.

BRONZE-c 1222

In this important campaign Bronze completed the ideas he had begun six years before in campaign 'X' when he located the height of the lancet arches, and hence the position of the rose and the top of the clerestory wall.



XVIII:49 Scarlet had shown in the western rose that he
XIX:33 would have preferred a higher vault, and
indeed this still would have been possible if a
domical system had been used. But Bronze's
appearance at this time ensured that his
scheme of 1217 would be completed as he had
XIX:10,11 planned. He finished the nave clerestory
XVIII:76 walls, with most of the cornice, and erected
XIX:4,16 the roof over it. He need not have completed
G:XIX-D the roof, and indeed probably did not, for it
would have been an immense task to raise
those weighty beams, removing part of the
temporary roof to do so, and to secure them,
frame up the subsidiary structure, line it with
boarding and then lay the lead. But he only
needed to get up one frame to determine the
roof heights throughout. Probably, as with the
arcade capitals, the first beams would have
been those in the middle of the nave.

XIX:67 With the roof he began the formwork to the
G:XIX-B nave vaults, for the geometry is entirely his.
XVIII:67 The bosses may have been Olive's, showing
that this work, and possibly the roof over it,
were completed in the next year.

The major change made in this campaign was
XIX:3-9,11-13 to eliminate the crossing tower. The low-
pitched roof that would probably have
accompanied a tower was changed into a steep
one, and the third row of flyers added to
withstand the wind loads on the roof.

With the roof and the vaults Bronze completed
G:XIX-B,C the geometric enclosure of the House of God
in a magnificent statement of wholeness, using
both the axial series bequeathed from Scarlet,
and his own spacial series based on

He must have removed the last of the nave
XVIII:63 clerestory scaffolding, for he was able to insert
XI:23 the last stones of the coping, with his
projecting heads.

He built the walls on the eastern side of the
XVIII:35 two rooms against the western towers, with a
thickness of one foot, and characteristic
corner-located windows. He set an arch into
this wall so that any side thrusts from the roof
would be taken into the older towers.

XVIII:30,76/m In the choir he laid the arches over the spokes
using his corbel-shape in the moulding, but
XiX:14 none of the copings. He probably began the
XVIII:5,58 walling under the clerestory roses, but without
the sub-frame which was left to Olive. The
bases to the pilasters between the roses are
lower than the caps at their centres, unlike the
XVIII:63 nave where the roses where set slightly lower
and the bases slightly higher, so their order of
construction was reversed.

The small amount of work being finished in the choir compared to what was being achieved in the nave suggests that he may have had to spend a lot of time erecting the spokes and the pierced arches over them. A tedious job for each member had to be supported at the correct angle, and progressively pinned and leaded into the adjoining plates. It may have been from the difficulties encountered in erecting the radiating spokes at Chartres that the masters were convinced that they should set them vertically on other buildings

They made no attempt to push the NE.II pier
XVIII:76 above the top of the flyers, unlike the west.
Presumably he considered that the amount
already built was sufficient to support the
thrusts from the crossing arches.

Bronze erected the first copings over the
XIV:46,47 sanctuary aedicule shafts, most of the latter
having been carved by Ruby. He probably
brought all the other aedicules to the level of
their caps, save the EN.I which had to wait
XVII:27 until the NE tower room was more advanced.
With the aedicules he could prepare the
seatings for the outer row of flyers elsewhere,
and they could have been formed up and the
voussoires laid.

In the apsidal towers he began laying the
XIV:16,17 masonry of the piers above the tori, with sharp
corners behind the shafts. The door from the
XIV:14 ES stairs had the corbels set up in this
campaign, while the stonework fell away
sharply from the door to below the aedicule
XX:40 cornice. On the other side Bronze was
continuing the octagon around the stairs
XIV:13 begun by Ruby, with the small window on the
east side.

In the south he redesigned the layout for the
XIV:26,29 towers, eliminating the shafts under the ribs of
G:XIV-D the tower vaults. The roof was finished in the
XX:32 west, with most of the cornices and plinths.
The roof water was discharged through the
XIII:57 plinths on the western side to spouts set over
two of his corbels. With this he completed the
XIII:62 colonnettes, and the arches over them: thus
bringing the western tower up to virtually the
same height as the eastern.

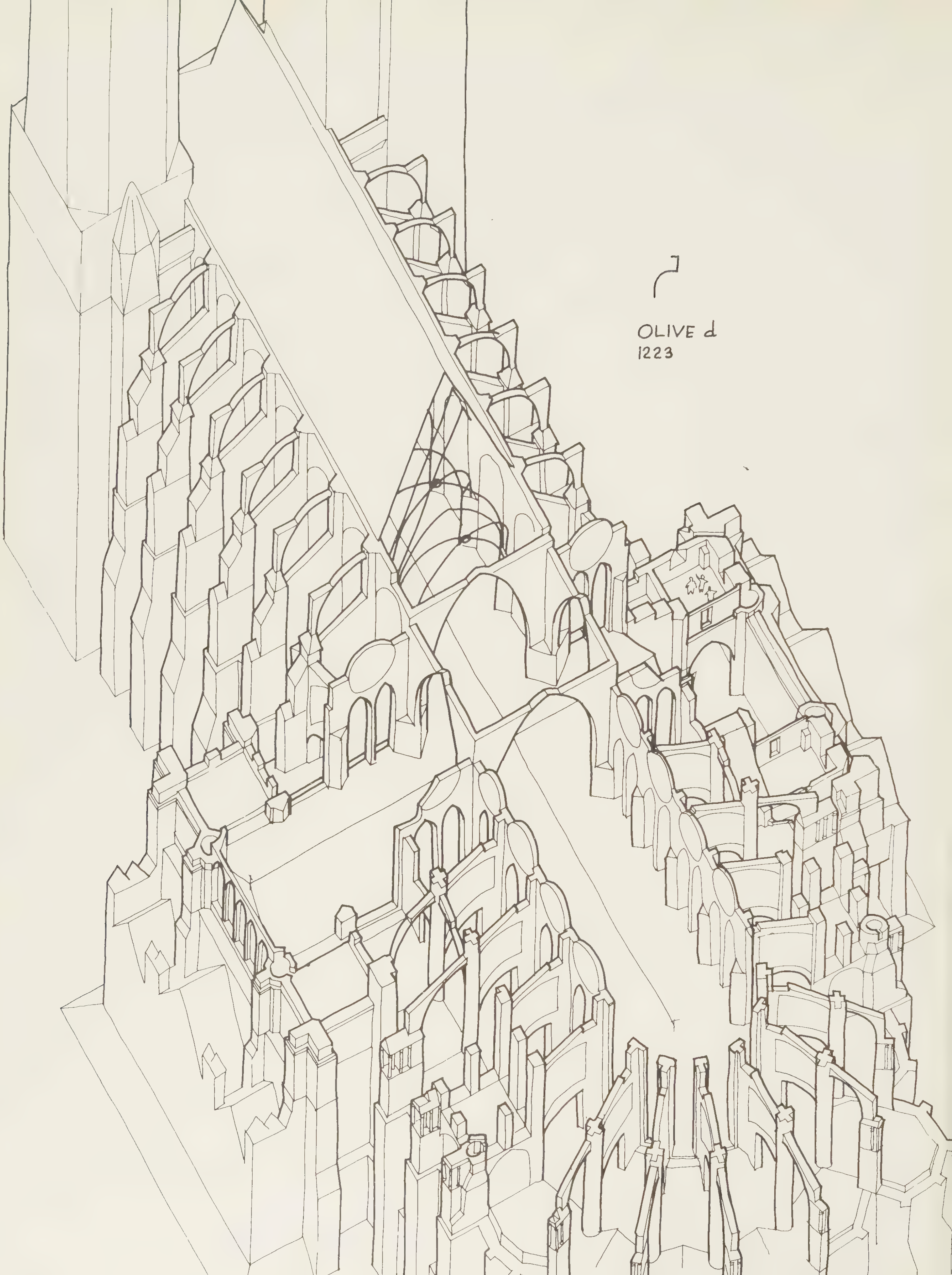
The NE pier of the eastern tower was pushed
XIII:18 up further to support the outer arch of the
XIV:22 flyers and on the other side he began the
SE(cw) door. Notice that for the first time the
coursing around the southern stairs is the same
XIV:27,31 height as the clerestory piers in bay II. Soon
they will be ahead.

XIII:11,62 With the stairs he began the arches over the
XX:32 five southern lancets, with the capitals over the
mullions. The southern transept sills were now
sufficiently complete for the temporary roof to
have been extended to the terminal wall.

And with the exception of two bases and tori
XIV:27 in the SW tower, the scaffolding could have
been erected for the construction of the piers.

XVII:13,15-17 In the north he laid a lot of stonework to
XVII:22,23 these rooms, as unlike other masters, he was
concerned with the delays here. He raised the
XIII:1 walls to the corbels over the northern and
XVII:12 interior doors though the work around the
stairs was, as usual, lower. This included the
springing in all rooms, including the ribs which
project out of the imposts. He modified
G:XVII-B Jade's geometry of the exterior, particularly
XII:10. XVII:10,13-16 in the outer piers.

XVII:29 Bronze also began the NW-W window, and
XV:41 finished the sills of the lancets and the
XVII:15 balustrade of the gallery. In the NE corner he
XII:6 laid the last stretch of cornice, with a short
column under it to continue the 'arcades'
begun on the other side in the previous
XVII:27 campaign. But unlike Jade's column, it is a
circular shaft rather than octagonal.


OLIVE d
1223

OLIVE-d 1223

Olive had worked on the site twice before - thirteen years earlier, and in the fourth campaign thirteen years before that. He XVIII:49 continued the work on the third row of flyers XIX:12 in the nave, probably setting up the walling over the arch and thereby helping to raise the level of the cornice above where Bronze would have had it. The cornice around the nave was XIX:10 now complete except for the section by the two small rooms alongside the western towers, and one stretch of the first bay on the south. This wall was thick enough to allow the roof beams to be set onto the inner skin, irrespective of wheather the cornice was there or not.

In completing the nave roof Olive must have finished the western end with some sort of gable-and-hip as the present stone gable was XXI:31 not commenced until 1250.

Under the roof Olive continued the ribs over XIX:18,20,21 Bronze's formwork to the bosses, and built the double layered tuffau cells between them. The vaults referred to in Le Breton's poem, dated I:6 between 1218 and 1224, could have been these though it could have been written after the formwork had gone up, or after the scaffolding was removed.

In the choir and in the first bays of both XVIII:30,76 transepts he set up the roses in the clerestory XVIII:5 in their characteristic frames. In the sanctuary he began the heavy arches over them, though work would have been lower in the transepts. The capitals and corbels at the centres of the XVIII:63 roses are his, as are the corbels under the arches over the apse lancets. The coursing between them gives some idea of the extent of VI:45 his work. It was quite a large campaign.

The great difference between the main vessel and the side arms is now particularly obvious. Even the southern side, which had not been held up like the north, was being allowed to drag its feet, and to advance at only the slowest pace. The way in which the first clerestory bay in the transepts was being built dictated the reason: as long as the crossing arches were adequately buttressed there was no need to spend money on the arms. The bulk of the funds and effort could go into fully completing the major and most important part of the edifice.

XVIII:67 The crossing structure was being pushed ahead of the walls to the east, as otherwise Rose in the next campaign would not have been able to set up this vault ahead of those in three of the adjacent arms. As the roof had to be over the vault, the walls that support it had to be higher than the choir, showing that it must have been pushed ahead quite quickly at this stage.

XIX:12,14 In the choir Olive continued with all the upper flyer arches, including the outer ones and the shorter ones in the apse, and may have begun XIX:14 the copings over them. The top of the outer arch meets the pier level with the top of the spokes, and so could not be begun over the aedicule until the pier had reached this height. In the north the outer arch to the NE tower could not be put in, and so a seating was left XVII:22 in the pier for it. The southern one could, of course, be put in.

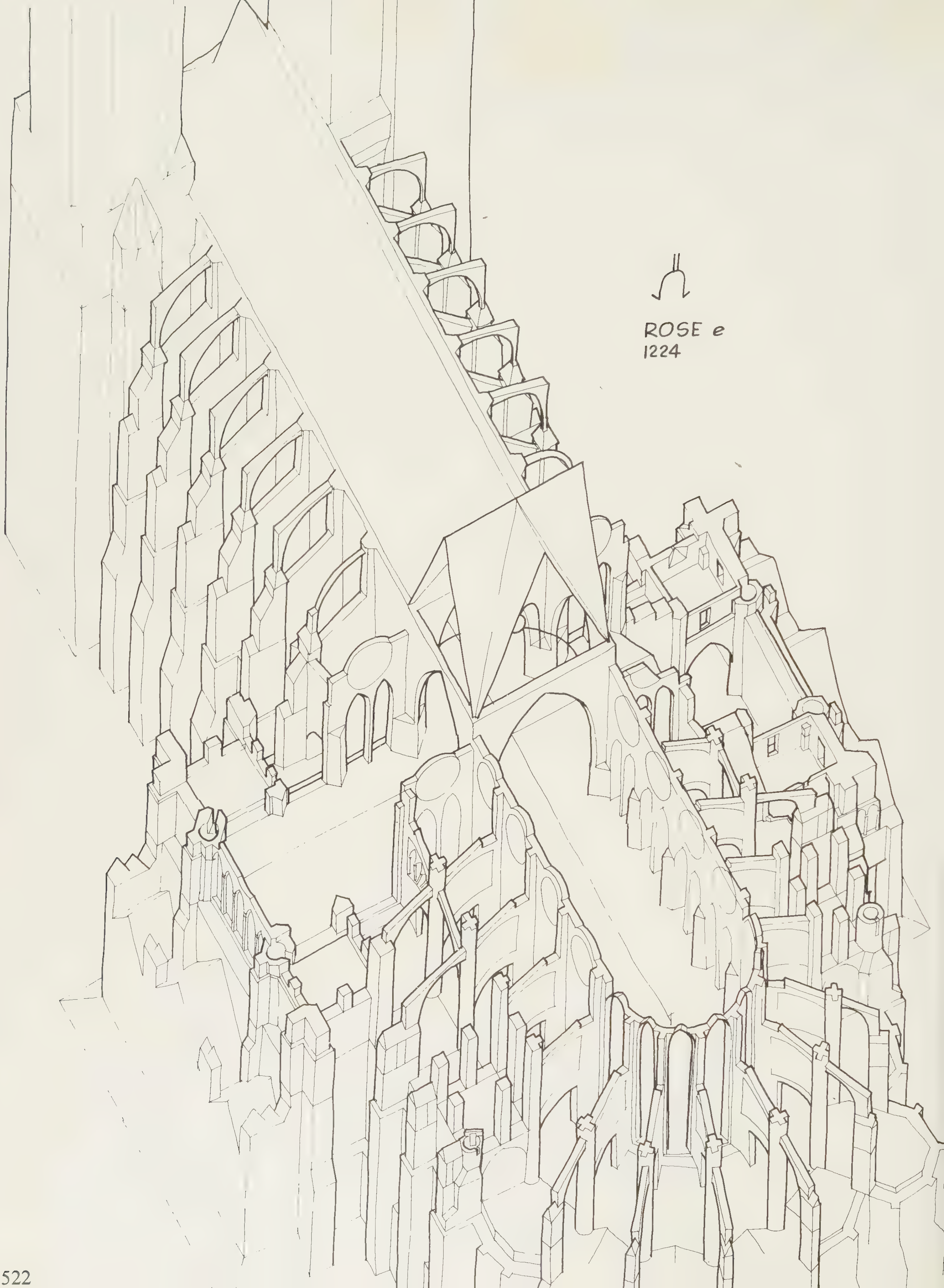
XIII:46,47 Olive continued roofing over the aedicules, and setting up the columns inside them. He completed those to E.II only.

He laid a few additional courses around the eastern stairs. The octagon around the ES still XIV:14 had not been started, but in the north the stair XX:40 was now halfway up the window, and Olive XIV:19 was cutting the bases to the circular shafts up the corners of the octagon.

XIV:26,29 Work continued slowly in the south, with the G:XIV-D plinths being put down, and most of the tori under the pier shafts. He altered the plan for XIV:27 the SE(cw) door, though in the west his work stopped just underneath the threshold.

XIX:32 Over the southern lancets he laid the arches, XIII:11 with the massive large blocks between them XX:32 and the rose to firmly secure this area. This reflects Olive's uncertainty here, and his determination to build it well, transforming this section of stonework into a beam of sorts to span between the stairs. This suggests he was planning a large window over the lancets, and that the stability of the wall would depend on the care of his workmanship over the lancets. At the same time he laid the capital XVIII:53 under the high vault rib on the SW side.

XVII:10,13-15,22 On the north he completed the NE.III pier, XII:10 altered Jade's geometry, and laid up a lot of XIII:1. XVII:30,31 corbels over the pssages. He began the XVII:23,24,29 windows from the NE stairs, and one from XVII:27,33 each of the rooms. Work in the north is progressing at twice the pace of the south, though still not as fast as in the nave and the choir. The delay in the north did not worry him.


ROSE e
1224

ROSE-e 1224

XVIII:49 Rose completed the upper nave flyers and
XIX:10,14 their copings, the last of the cornices and with
them the roofs over the little rooms against the
western towers. He probably completed the
render to the nave vaults, painted them, and
removed the last of the scaffolding. The glass
could now be installed into all the upper nave
XIX:27 windows, and the full magnificence of the
cathedral, its noble proportions, shimmering
glass and luminous spaces could be appreciated
for the first time. What a moment it
must have been. No wonder that Guillaume
I:6 le Breton exclaimed that next to Chartres
"none in the world gleams so brightly this
day."

XVIII:67 Around the crossing Rose must have
completed the wall and raised the roof over it,
XIX:18 for he set up the ribs and boss of its vault. His
G:XIX-C geometry is different to 'Bronze's' using a
pentagonal figure that related the boss to the springing of the capitals and to the plan dimensions of the crossing itself, whereas Bronze's proportions ignored these capitals and stemmed from the standard bay and span. It is interesting to see that Rose had initiated this geometry in 1196, and had continued with it unswervingly throughout the next two decades.

The walling over the third flyers next to the crossing could not be completed as it would have had to be tied in with the adjoining arch to the transept, and this was to be almost a decade away. Virtually nothing was added to the western walls of the transept, nor to the
NE.I bay. But on the south Rose added the
XVIII:58,70 spokes and the arches over them. He
articulated the spokes with capitals and bases as if it was important to match those on the other side of the transept, rather than their close neighbours in the choir.

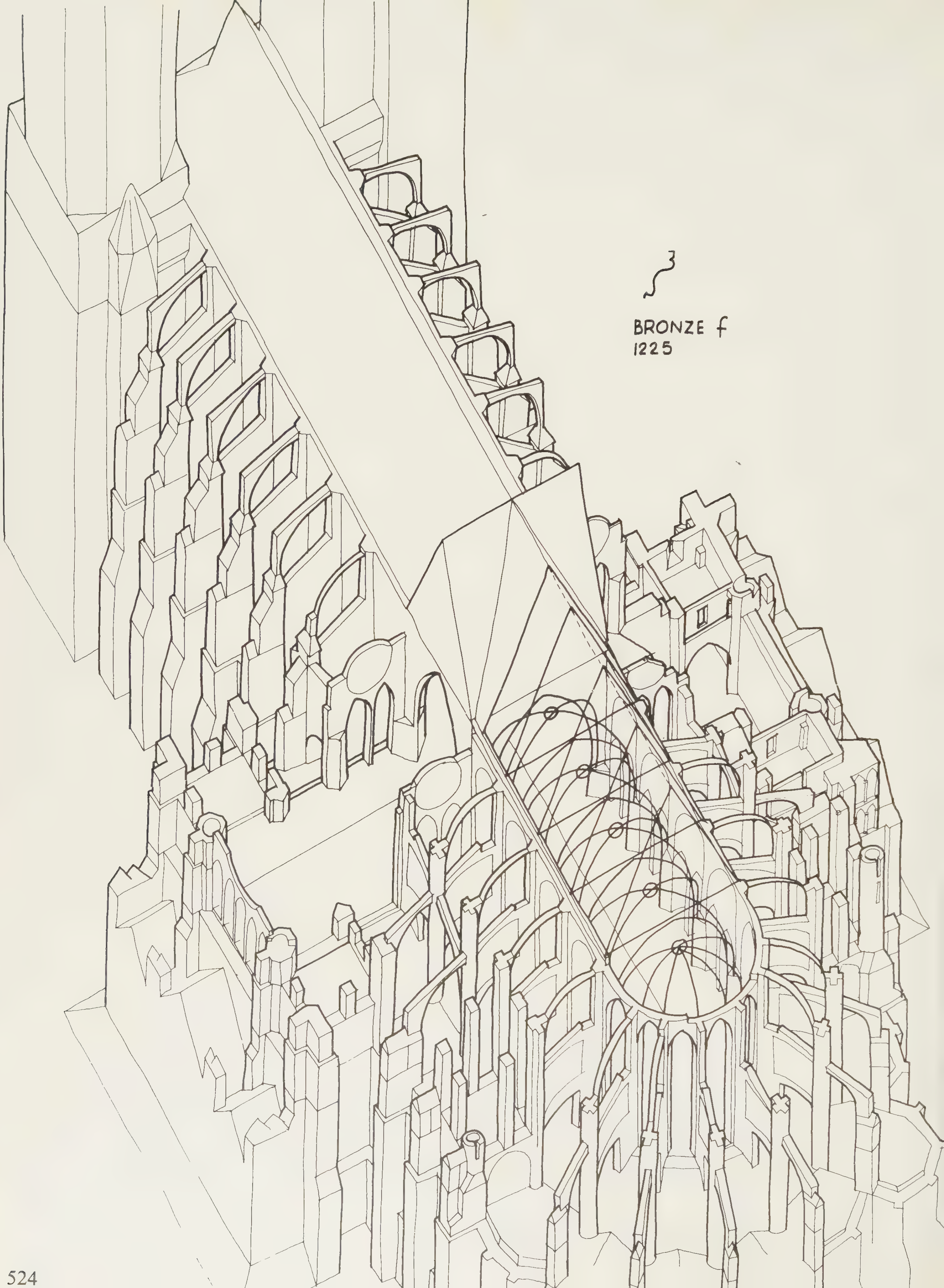
XVIII:76 Down the walls of the sanctuary he arched
XVIII:63 over all the roses, laid some of the pilaster
XIX:10 caps, and round the apse completed the lancet
arches thus locking all these piers together and
stabilising the eastern end of the building.

XIV:20 He completed the eastern aedicules, and
XIII:47 brought up the central flyer pier to the
XVIII:30 lowest voussoires of the third row. Like Ruby
Rose chamfered the edges of his voussoires.
XIX:10 The piers of the ES tower closest to the choir
XX:40 were now high enough for him to install the
XX:37 caps under the ribs, though the piers of the
northern tower were lower - except for the
work around the stairs where the position was
XIV:10,14 reversed. He carved the lintel over the EN door
with the groove in it for the hinge, and
completed the nearby window with much of
the walling around the stairs. The shafts up the
XIV:14 corners of its octagon were, unlike the north,
en delit. By comparison the ES stair had only
XIV:13 reached the sill of its window. The small
change to the edge of the mouldings of the
norther piers indicate the relative heights at the
XIV:17 end of this campaign.

XIV:27 In the south he set out the SW(cw) door, and
XIV:26,29 the capital under the high vault ribs over
XVIII:53 SE.III. He began the frame around the
XX:32 southern rose, and he may have cut it in this
XX:26,27 campaign, erecting it when he returned in
1229.

The piers in bay S.II are still a lot lower than those further south. The corbels on the west are his, as was one on the east, but the latter was probably not erected in this campaign,
XIV:30,31 being mutilated before being installed.

In the north he did little more than cap
XVII:10,13-15,22 over the external door and passages, and
XIII:1. XVII:13 laid corbels around the NE.II passage.
XVII:27,33 Most importantly he laid the inclined flashing
XVII:14,30,31 stones on the southern side of these rooms.
The last of the plinths over the triforium
XII:10 walkway were laid, under the piers on the
XVII:10 outside of the walkway around the stairs. Rose
was not concerned with the unbuilt outer arch from the EN.I flyer to the NE tower. It was not to become a problem until the next campaign.



BRONZE f
1225

BRONZE-f 1225

XIX:10 In the choir Bronze laid up most of the third
XIX:14 row of flyers, and began their copings. They
XIX:10 rested against the great blocks projecting from
the wall just below the roof cornice. These
copings are innovative, for instead of throwing
XXII the water to each side of the arch, it channelled
it to the outside of the building. In time this led
to the integrated roof-and-flyer gutters that
discharged all the rainwater through gargoyles
beyond the walls.

The inner skin of the clerestory walls would
have been raised another course so that the
XVIII:67 heavy roof beams could be set onto them, and
while the roof structure was being erected
XIX:18 Bronze formed for and laid the ribs to the high
vaults. The only parts he did not complete
were a few of the blocks and arches round the
apse and the cornice. Presumably part of the
hemicycle roof was set up in the next
campaign.

I have presumed that as there are no heads projecting from the upper stones of the coping over the middle flyers, he did not lay them, but was still using the masonry underneath to support his scaffolding.

There was still a serious lag on the north side.
XVIII:76 The NE.I transept flyer spokes were not in yet,
nor the third flyer which sat on it. Nor was the
outer arch as the pier of the NE tower on
which it would have rested was still too low.
Bronze must have felt that this hole was going
to be an embarassment if left, especially after
the formwork was stripped from under the
nearby vaults. He therefore committed an
exceptionally large part of his workforce to
this side.

Firstly he raised the pier of the NE tower at
XVII:27 least seven courses, so that in the next
campaign Jade would be able to complete the
flyers in this bay. Secondly he raised the EN
XX:40 tower well above that of the south, adding
XX:7 some 25 square-cornered treads, along with
XX:4 two windows, and the whole of the encasing
walls of the stairs up to the caps under the
tower ribs. I think he pushed this tower ahead
XX:37 so fast to secure the northern side of the choir,
and to compensate for the missing flyer arches
in the first bay. Was his anxiety not shared by
his predecessors because they had intended to
act more slowly in putting up the vaults? Or
did Bronze get his ribs up somewhat ahead of
the normal order of construction? And if so,
was he trying to ensure that the eastern vaults
would be completed to the same height as
those he had put over the nave? Did he fear
G:XIX-B that the geometry of his solution would be
modified by his successors, and so he
determined to get in first - a sort of medieval
egomania, perhaps?

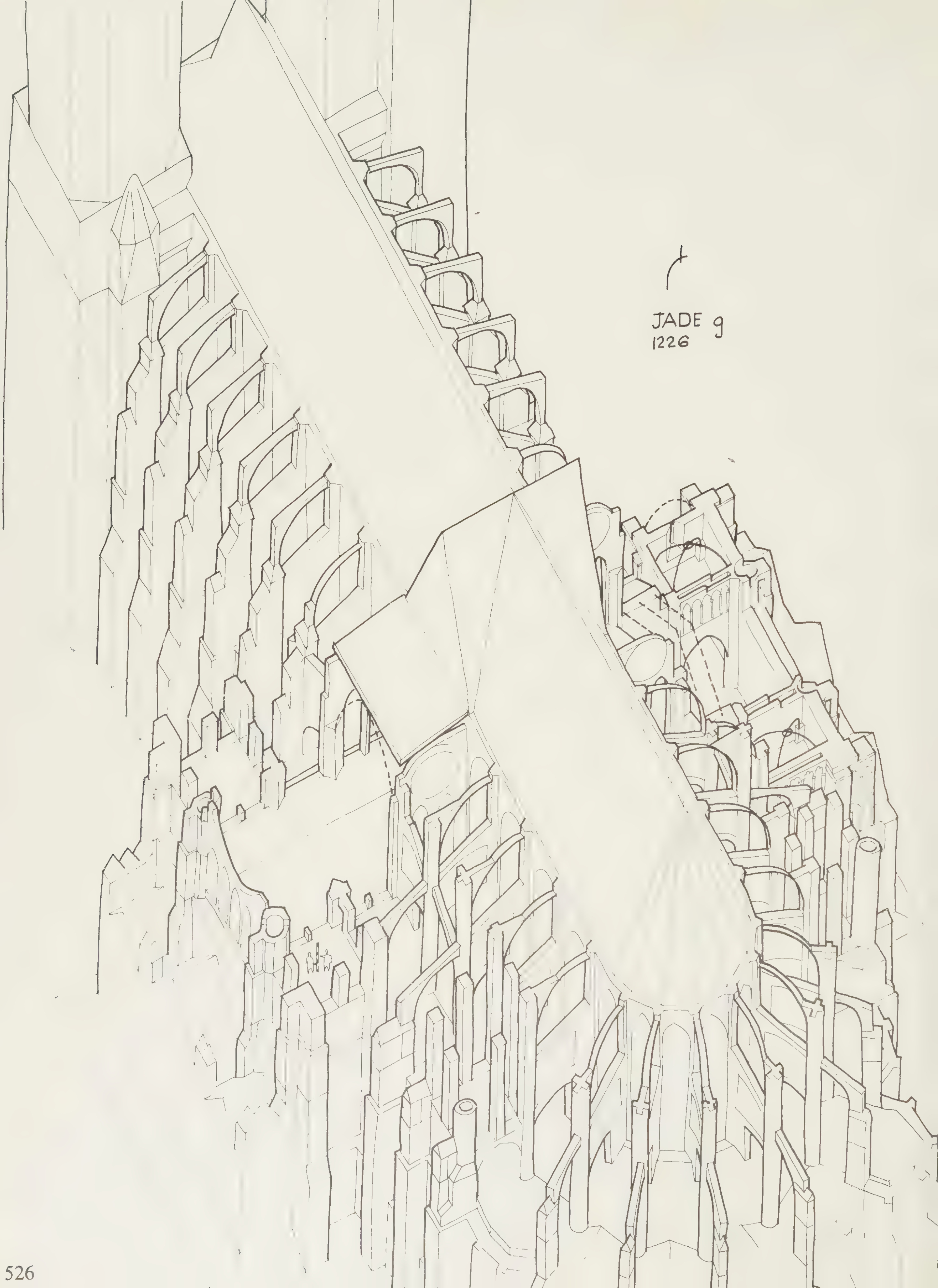
The amount added onto the EN piers lies
XIV:16,17 between the altered outline of the masonry
XX:37,40 behind the shafts to the capitals under the ribs.
XIX:3 It includes two of his windows. Around the
stairs on the south he laid a few courses
around the lower window, and began the
XIV:14 engaged shafts on the corners of the octagon
but no treads. However, the other piers must
have been well up, if the pattern in the north
was not too dissimilar to that in the south.

XIV:28 In the south transept he laid the corbels over
both clerestory doors, where a new shape
appears in them for the first time. A few
XX:31,32 courses were laid above that with the window
on the SW, and more of the frame around the
rose with some of the lowest voussoires to the
XIV:29-31 high vault ribs. By contrast the piers in bay II
were not even up to the capitals.

In constructing the tower piers the scaffolding involved and the slenderness of the structure would have inevitably slowed up the work. In one sense, though, the quicker they built the safer it would be, as the tall piers would not have as long to wait before being tied together at the tops of their vaults.

XVII:13-16,22,33 He laid over a meter of walling around the
northern rooms. As in his previous campaign
he did his best to push this section ahead,
whilst others were content to let it limp along
somewhat more slowly than the central
XVII:3,5,27 clerestory. This included building the second
row of shafts and their arches to the 'arcade'
that was to be carried over the north porch. He
altered the NW-W window, and placed the
XVII:25,26,29,30 northernmost caps of the triforium arcade,
XVII:32 ready for this zone to be completed in the next
two campaigns.

On the two outermost buttresses of the
northern towers, on the southern side, he laid
XVII:35,36 the cornices at the same levels as those that
adjoined them in the nave and choir. The fact
that they were not at the same level produced
XIII:44 some quite serious problems later on when the
bases under the towers came to be built.
Perhaps Bronze had intended this zone in
some other way, without the use of aedicules.


JADE 9
1226

JADE-g 1226

This was the 32nd campaign. Save for a few
oddments, the nave, the choir and the crossing
were complete. The temporary roof at
triforium level may have been removed from
over the choir in the next year, with the last of
the scaffolding and the stained glass were put
into the choir. From the western rose to the
XIX:27 great eastern lancets the full awe-inspiring
grandeur of the cathedral was now displayed
to all.

Over the first transept bays Jade built most of
XVIII:30,76 the heavy stonework over the roses, thus
XIX:10 securing these walls to the crossing. He may
have begun forming for the vaults, and with
them would have constructed a temporary
roof over these bays. It would have had to
have been a lean-to as the piers of the first bay
were not high enough to support the main roof
itself, and anyway, the wind loads may have
been too great on this unprotected end.

As it was, in the next year when Ruby
XIX:18,19 completed these vaults, he tied the transverse
arches and their bosses to the crossing with
wooden beams. The ubiquitous use of the
wooden ties is one of this trade marks. At the
XVIII:71-73 same time he would have inserted the spokes
and arches to the NE.I flyer.

XVIII:73 Jade was able to consolidate this corner of the
choir by completing the now lofty nearby pier
of the NE tower, laying the arch between it
and the EN.I flyer, and probably setting up
XVII:27 the third arch over it. With it came the cells of
the choir vaults, and their render.

He did not do as much work to the ES tower
piers as to the north, though the last of the
capitals, under the ribs as well as under the
arches between the piers, were to be completed
XX:37,40 in the next campaign. Ruby's campaign was a
large one in the south, like Bronze's had been
XIX:2,40 in the north. Now that the EN.I corner had
been stablised, the imbalance between the two
towers would have been obvious. By the end of
1227 Ruby had raised the stairs of the southern
tower to about the same level as the north's.

In the southern transept Jade continued the
wall around the rose to about one quarter of
the way up, plus a fair number of courses to
XX:31,32 the piers and one window. Over the piers along
XVIII:53 axis II he laid the caps, cutting it for a circular
shaft whereas below it was octagonal. The two
XIV:29,30 corbels cut by his predecessors Rose and
Bronze for the SE.II walkway were altered and
so placed that they resembled Jade's own
shape - a trick Scarlet had played on Rose
some years before. In the next campaign Ruby
was to complete this pier to the springing for
the lancet arches, some five courses, and
would construct the arches themselves, thus
removing the last hole in these walls and
helping to stabilise the adjoining bay that he
was vaulting. So Jade probably began the
mullions in these bays.

XVII:13,15,22,33 In the north Jade cut and erected all the
XVII:32 triforium columns, and installed the arches
XIII:1 over them, with a few corbels. The triforium
XVII:34 temporary roof could now be extended across
the last bays of the north transept, a welcome
addition to this end of the building which
could have been completed in the next year. In
the tower rooms he could have laid up the
XVII:14 formwork for the ribs, though the bosses are
XX:9 Ruby's. On the west he began the arch over
XVII:15 the outside, and on the east installed the
XVII:27 arcades with their curiously cut plate-like
arches.

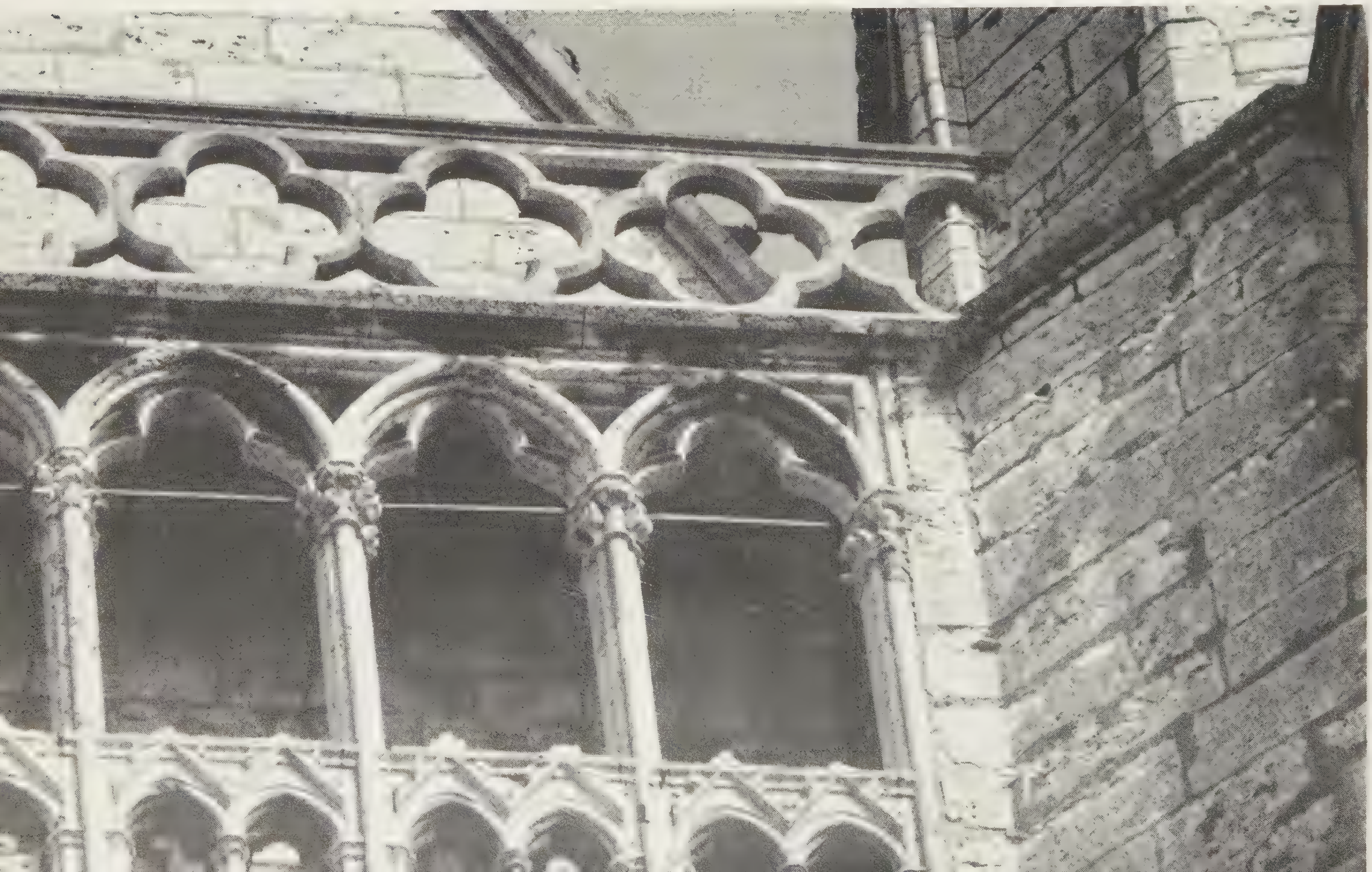
Jade also continued Bronze's two cornice
XVII:36 levels across the north front so that one side
was now 400mm lower than the other. Perhaps
on the side facades these differences could
have been made up, but now, exposed as they
were on the facade itself, they could only be
accepted and, hopefully, remain unnoticed.

There is little point in continuing these
isometrics beyond here. It is now taking longer
to draw in what has already been finished than
the new work. A set illustrating only the work
done in the transepts might be useful, but it is
not nearly as complex as the interlocking
situations that occurred in earlier campaigns.
XX:40 In five programs the EN tower would be
finished, and in another two the ES in spite of
XX:38 the partial collapse of the vaulting formwork.
XIX:18 But the southern transept vaults were to take
XX:32 another ten years, and the north, still many
XX:9 meters below the south, a further eight.

Way back in 1200 the Job doorway had been delayed eight years altogether, and it is interesting to note that the difference in heights caused by this delay seem to have been maintained to the end.

XX:42 After that the gables were gradually finished to
complete the work, though they were to drag
XXI on into the 1270's, half a century after the last
work on the nave and choir. The transept and
apsidal towers were to be capped off and left
incomplete as the dream of the 1190's gave
way before the lesser enthusiasms of the later
1200's. Altogether it would take as many
building campaigns to finish these oddments
as it had taken to build the rest of the
cathedral. How times had changed.

PHOTO 528: *The gallery screen across the southern transept.*



TWENTY ONE

Capping the incomplete

Whilst standing there I am reminded in a curious way of those temples buried in the jungle in Angkor. They also were large and magnificent, and in the end had to be abandoned, no one knows why. But may it not have been that here also the civilisation became unwieldy, became top-heavy and too expensive, and so was abandoned, and presently the bitter Karela grew and seeded, and covered it all.

Arvind Nehru.

The original cathedral was to have extended itself high into the clouds with nine towers and spires. But by the time the third generation of masters had been at work on it the funds began to run out, and people's ideas were changing. The grand verticals of the towers were abandoned, leaving just the simple steep roof and the two spires at the western end.

At the top of the transept towers there are still a few stones which show they had at least begun the next stage of the towers. From the ground the clusters of shafts can still be seen against the stairs, especially in the NW. The level at which the preparation for the next stage petered out must represent a line of constant date, when the Decision was taken to abandon the old scheme. Above that line the size of all four towers was reduced, and the stairs were capped with small octagonal turrets which unmistakably mark the end of the tower scheme. This Decision was one of the most important taken by the Chapter. A line was drawn through the accounts. The old dream was cancelled and the wooden model with its thrusting silhouette put aside. Perhaps they realised that the flow of funds would never improve, and that as it had taken nine campaigns to get the gables even half way up they would be hard pressed to finish the towers before Judgement Day itself.

Also artistic taste was changing, as we can see elsewhere in France, towards a more horizontal form accented only by a pair of western spires and the occasional small wooden lanterns supported on the roof ridge. The unapologetic verticalism of Laon and Lahn was now a thing of the past. Be it for money or for taste, the Chapter scrapped the old scheme. We have only to look at the amount of work done on the cathedral over the next two or three centuries to see how right they were. The small funds they had were only enough to build the small chapel of St. Piat, the miniscule Vendôme Chapel, and, after a century of collecting, the screen round the choir. The only heavy expenditure from the last of the roses to the new roof in the nineteenth century was the spire over the WN tower by Jehan de Beauce. Both the spire and the roof had to suffer a major catastrophe to get them under way. Otherwise for almost three hundred years only minor peripheral work was done on the cathedral. The money they did spend shows they would not have had enough funds to finish one tower, let alone six or seven.

I presume that the Decision was taken towards the middle of the century, perhaps just before Louis IX consecrated the cathedral in 1260.[1] There could be many reasons for having the dedication at this time. The stonework may have been sufficiently complete for them to dedicate the interior, the glass may have been installed, it may have been a suitable political occasion to suit the Chapter's policy of maintaining Chartre's primacy among the Virgin's churches in France, or even a wish to have Louis, who was now an old man, carry out the ceremony before he died. But it may have also marked the turning point in the attitude of the clergy to their building, when they finally admitted that the great cathedral would never be completed to the first grandiose design. Naturally in one sense no cathedral could ever be completed, for one could always find new work to do in cloisters, chapels and porches, and so the dedication is essentially the formal celebration of the fact that the clergy of 1250 were not like their earlier brethren, and wished to turn their attention to other matters.

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[1] Lepinois and Merlet, 1862, ii, pp.169-70. Translated in Branner, 1969, p.99-100. See discussion van der Meulen, 1967, p.153, n.16.

I have preferred this date for the Decision because it places the transept gable sculpture and the sacristy tracery into the 1270's, where stylistically many scholars feel it belongs - n.28. As I have spread the dates for the campaigns fairly evenly over the 35 years they are vety approximate indeed.

However the Decision may have occurred closer to 1250, and the gables, WN tower and sacristy have been completed by 1260. These alternative dates will be shown in square brackets [ ].

In support of this alternative we have a number of documentary references to gifts for a tower. During the 1240's Arnoul Payen de Mongerville gave a gift of flour, and before 1250 two canons gave money "ad opus turris" (Lepinois and Merlet, iii, p.155, 224 and 270). Neither of these donations are more specific, and could have referred to the work then being done on the transept towers.

The gift of a large bell "in turri nova" by Pierre de Bordeaux in 1260 or 1264 (*ibid,* iii, p.162 and Lefévre-Pontalis, 1950, p.408) is more specific, and may have referred to a great bell in a newly completed WN tower and/or spire. But there were bells in the stump of the tower in 1240, which I feel is too early for the completion of the WN tower (from crew order, and from work done elsewhere in the cathedral). This bell was noted during the burial service of Bishop Aubry (*ibid,* iii, p.198).

None of these documents are specific enough to enable us to date the WN tower before the Decision, yet the possibility remains. In which case Pierre's great bell may have been installed in time for the Consecration of 1260, which would then have been occasioned by the true completion of the cathedral, including gables, capped off transept towers and the fully completed WN tower and sacristy.

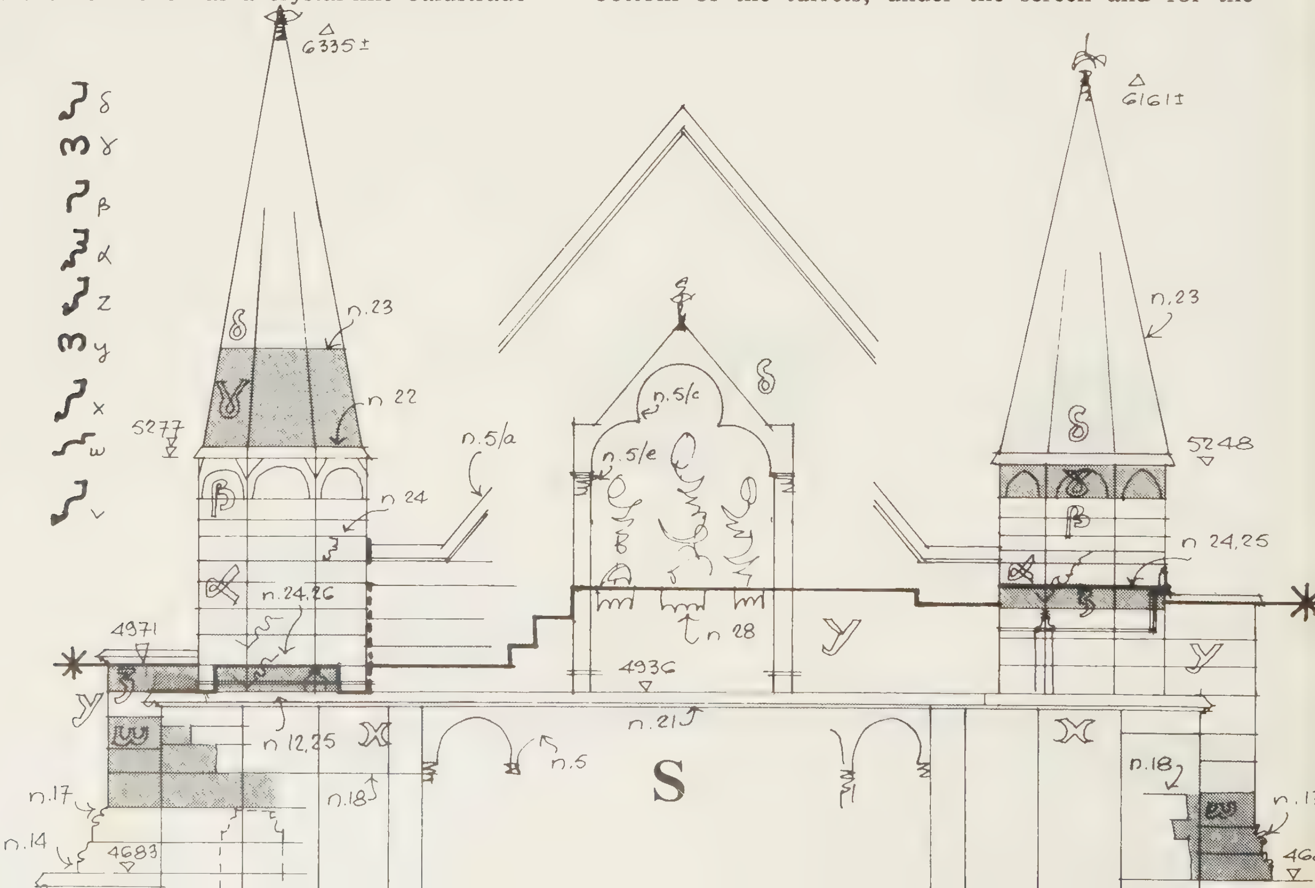
The Decision may not have come as a sudden surprise, for the facts would have gradually forced themselves on the clergy as they realised that the momentum of the previous half century had exhausted itself, and that both men and funds were lacking. The step between noticing the changing tempo and recognising that it was not a temporary but a permanent state of affairs may have taken many years, perhaps even the full period between the finishing of the north rose and the Decision.[2]

The dedication therefore marked the ennui of the times where the restless urge to go on building and endlessly adding had spent itself. It stated that the church would now be satisfied with what it had got. During the years when they must have been pondering the Decision the two transept gables were brought to roughly the same level. Work on the south paused with the hip roof over the gallery, but the north kept on advancing steadily until by the time they came to build the screens, Sapphire was able to carve both at the one time with the cornice over them. On the inside it rests on his corbels.[3]

His screens are unusually light for Chartres, complex in shape with firmly edged leaf caps which could only be the work of one master. Though the northern one sits on the solid plinth Bronze had built four campaigns earlier,[4] the southern one has a crystal-like balustrade with the flame-speckled gables of the Parisian Court School.[5] In the north Sapphire began the screen with a half arch against each flanking wall so the posts would not have to sit over the two bases Green had carved a few years before.[6] Even in 1250 no master would disturb an earlier stone, but would adapt his design around it. The style of this base was closer to those in the first campaigns of the cathedral than to the contemporary work at Ste. Chapelle and the Court style of the mid 1200's.[7] Green's style was now old fashioned, for the new architecture was lighter, with elegant delicate mouldings and carefully cut outlines. The two have few points of compatibility. It was the courtier meeting the countryman.

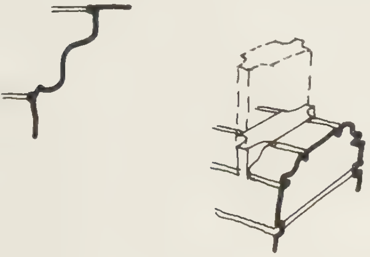
From the inside stonework of the southern side of the gallery you can see the full destructive effects of the fire of 1836. The face of the wall has been burnt, and massive chunks of stone have been split off leaving a pink scar-tissue over the surface. Further up along a clearly defined line level with a row of holes left in the masonry the damage suddenly becomes less. It is as if the roof had once had a hip and that when the gable wall and their tabernacles were finished the ridge line was extended to give it is present form.[8] The hip must have been left underneath the roof alongside the gable when it was built, and would have helped to protect the wall when the fire came. The stonework suggests that this was the position of the temporary roof built over the southern bays while they finished the end vaults, and that it remained there after the gables were extended above it.[9]

The key to understanding the work in the gables[10] lies in the many bases carved for the tower shafts, around the bottom of the turrets, under the screen and for the



2. From the details discussed in XX:42, the dossiers of the teams we know, and the items later in this chapter, the bases in the SW were begun by Query-r after Bronze had laid the cornices in 1238, but no other tower bases were begun for the next six years or so, even though it would have been natural to do so. All the walling behind these bases had been built many courses higher, and yet they stepped the work down so they could avoid starting the real work of the towers. The first master to work on the bases after Query was Damson-v in the mid '40's, and they were then continued by all later masters up to the Decision. These are years during which the clergy may have been vascilating.

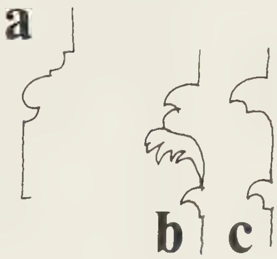
3. This is Sapphire-x in 1256 [1247]. His corbels are placed under the walkway slabs in both transepts. The double roll without a sharp edge is quite different to any other in the building, and is therefore a new team. The same corbel appears in the west towers in n.36, the sacristy in n.37 g, and in the chapter house in n.44/a. He may be Simon Dagon - n.46, 47.



4. XX:42/p. The joints with Sapphire are obvious, for all of his have small upstands in the top moulding for his screen, while Bronze's and Green's have none.

5. First found in Chartres in the canopy over the small sculptures carved in the N.w-w,e lintel XV:24 and nearby text. Are there any connections between the carvers in Olive's crew in 1210 and the leader of the flame-using Sapphire crew? and between him and the similar flames found a decade later in the Seez choir and the transepts of Notre-Dame, Paris? The same flame-like forms may be seen in his capitals - n.10 and 31/o.

a. The mouldings used in the southern screen bases **a** are those under the SW turret -n.24.



b. Caps are formed from blockily formed leaved arranged in separate clusters over the capitals **b**. They are also found in the sacristy bosses - n.32/j, and the NE turret -n.27. The caps are built into the wall above Green's corbels which helps to locate the joint.

c. The arches are built up out of a number of roll-moulds. The inner ones peel off to form a separate sharply-pointed 3-foil within the arch. Tracery contained within tracery. He uses the same idea in later campaigns over the gable tabernacles of n.10, over the Gallery of Kings - n.31/o.

d. His foot measure may be the Punic of 284mm - n.44/b.

e. The balustrade is cut with this section **c** which he used later in the unleafed capitals over the tabernacles - n.10.

f. The height of both screens is the same, showing that they were set out to their own rules, and not to either the width of the facade or the distance to the ground. Perhaps at 13^{PF} from gallery to balcony pavings.

6. XX:42. The bases have the chamfered corners Green used under the towers in 1228, rather than the continuous groove of Bronze -see XIV:14.

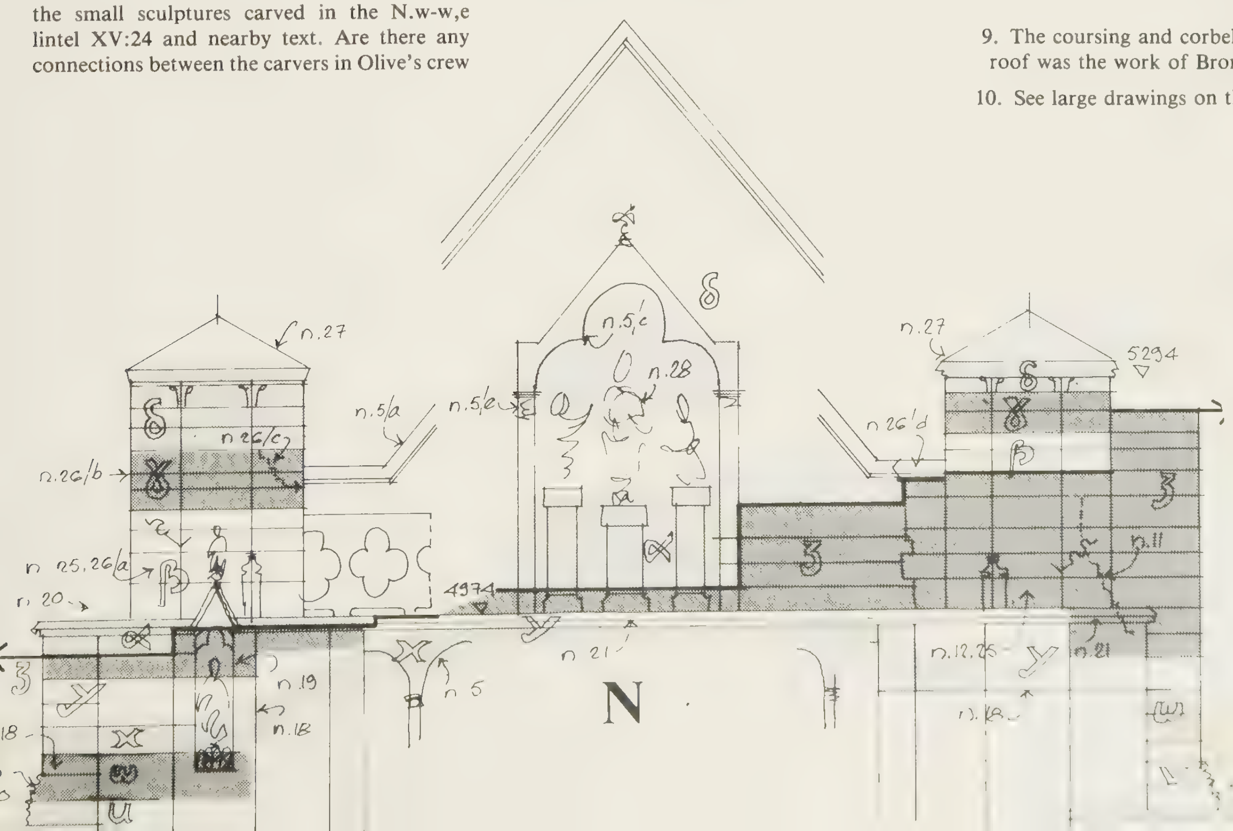
7. Branner, 1965. From careful measurements I made of Ste. Chapelle, the geometry disclosed three masters - one in the crypt up to the vault arches and ribs, a second in the cells and crypt window arches, and a third who completed the crypt and built the whole of the chapel to its vaults. Presumably money was not a limitation, and so the masters would have left for other reasons: each time where the stonework had to be allowed to stand while the mortar set. Being a small building the masters had to leave when they had reached these levels for there was no work for them to do.

The geometry of the first master is based on a 7:11:13 right-angled triangle (the side walls actually converge to match the mathematical error in the hypoteneuse) and a unit of 1,072mm. The plan and section of the upper chapel by the third master are both based on ɕρ:3. Could this have been Bronze, from GEOM:XIX-B & D? There is today a Bronze corbel over the eastern crypt door, but it does not appear in the de Lassus drawings of 1850 - is it a replacement?

8. The timbers of the hip roof passed over the gable wall about level with the underside of Sapphire's corbels in n.3. The corbels were placed afterwards, leaving the rafters in place, XX:42/x.

9. The coursing and corbels show that this hip roof was the work of Bronze-u in 1242.

10. See large drawings on these two pages.



tabernacle over it. To this must be added those in the sacristy and the WN tower which were being built at the same time. It has not been easy to bring this information together as none of the parts are physically joined to one another. We cannot relate them together with any certainty, but the crews seem to have replaced each other in much the same order in each spot, from which I came to the conclusion that the sacristy and the upper or fourth stage of the WN tower were both begun as the gables were being finished in the last campaigns before the Dedication. I have in these drawings shown the campaigns in the gables, and in a thick black line marked the level of the Decision.[10]

As you can see from this line the NW tower was the most advanced, possibly reflecting in a paradoxical way its earlier backwardness. This corner of the building had been held back over problems with the sculpture since 1204 or so, and for the rest of the way had lagged a little behind the NE tower. So one of the great wheel cranes may still have been in use on this side while those around the other towers may have been removed or replaced with lighter derricks. The big crane would have made it easier to push this corner ahead of the others.

Inside the staircase of the NW tower the last master before the Decision began to reduce the width of the stairs with corbelling which is built in, course by course, with the turret shafts on the outside.[11] He began the first of the small octagonal turrets over the stairs, meaning to stop the stairs there,[12] for they could not have been continued up these corners without distorting the outline of the towers from the street. It would have made the inner corner of the tower heavier than the others and would have unduly emphasised the space between them, denying the symmetrical two-fingered form they seem to prefer in the upper parts of their facades.

Clearly he intended to move the staircases from the front to a new position on the far side of the tower where it could not be seen so readily from below, as they did at Laon. After the Decision later masters continued the idea of turrets as a handy device for capping off the stairs.

Superficially all four turrets follow the same plan and, except for their roofs, it would be easy to think that they were all the work of the one master. Similarly with the bases begun for the piers of the towers. Yet when examined closely it is obvious that many men worked on each of them. Let us begin by examining the layout for the tower shafts.

The arrangement for the NE tower is similar to the SE in its dimensions and mouldings.[13] There were to be only two large shafts A and B with a small roll-mould R attached to A. It is more sculptural and less structural than the earlier work in the cathedral. In comparison the bases in the SW are much closer to the earlier style for they have three shafts sitting on old-fashioned tori not

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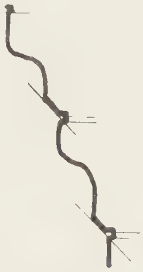
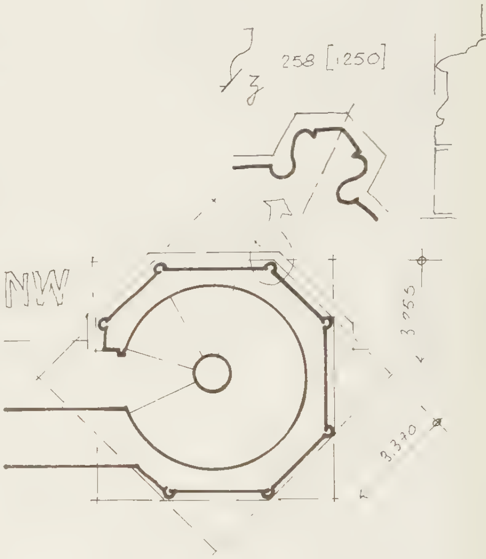
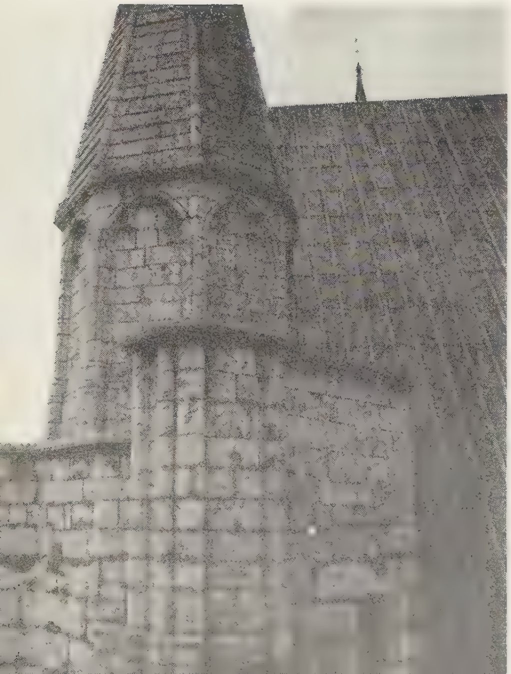


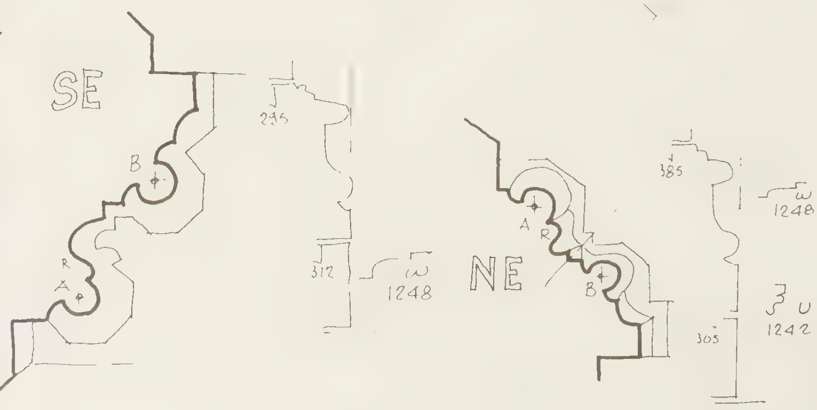
[11] See location in n.10. Though similar to Sapphire, the straight cut along the bottom and his details in the dossier show that his is not the same. I call him Damson.

[12] This is the plan of the NW turret. The octagon is formed from the squares shown in the corner of the drawing. The bases and the re-entrant corners used in them are closest to the tower bases some nine courses lower down - n.15. This shows him to be one of the most advanced masters working in Chartres at this time producing a fluid design more worthy of the end of the century than the middle. The work over him shows that the date of this campaign is about 1245, and again emphasises that dating by style is, even in this period, dangerous.





13.



unlike those used in the clerestory level almost twenty years earlier.[14] The bases are set square to one another without any of the curves, octagons or angulations found in the SE.

The most interesting arrangement of shafts is in the NW tower.[15] Like the NE it was to have three shafts, but the inside edge of each roll continued without a crease into the wall at D. The tori are also similar, but they sit on a plinth with splayed recesses which smooth out and simplify the complex forms above. The plinth is particularly beautiful, and is cut with exquisite care. These masons treated the stone as if it was malleable putty, expressing erogenous curves and swellings of an organic rather than a calcified nature. These bases are the form of the future.

Returning to the NE, a closer examination of the bases shows that the plinth is unlike the one under its SE brother, even though the shafts over it are the same. Only in the SE is the plinth suited to the shafts; in the NE it seems to have been laid by an earlier master, and the joint can be followed around the wall to the nearby door where the torus lines up with a somewhat mutilated corbel by the crew I call Lemon.[16] Hence the master who laid both plinth and torus course in the NE laid only the latter in the SE, adapting an old-fashioned arrangement of projections to his new more fluid shafts and mouldings above that.

A similar examination of the most old-fashioned of all the bases, the SW, shows another joint between the torus and the shafts above it.[17] A simple set of shafts was intended, but they built a more complex silhouette with re-entrant mouldings between the shafts. On the inside of the stairs this joint coincides with a change in the treads, and with the underside of the lintel over the doors out of the staircase.[18] It is possible to extract the work of no less than five masters from the tower bases, and they are depicted on the elevation on the previous page.

On the outside of the NE stair there is a niche containing a figure lost in prayer. It is capped with a delicate cusped arch and gable. Charming and fragile, it appears only in this buttress, and must have been begun in the years before the Decision. It may have been put in to unify the difficult junction between the next stage of the tower and the mass of the lower facade. It helps to tone down the weight of this corner and redress the unavoidable heaviness of the inner corner of the towers.[19] I presume that there are no niches in the other towers as this master did not have the chance of working on the lower faces of the stairs. He is therefore one of the later men and this tower must be one of the most backward.

The bottom of the niche and the leaf-encrusted support under the statue were built with the torus and the shafts nearby. Further, in this photo of the inside face of this tower there are two hefty columns placed on either side of

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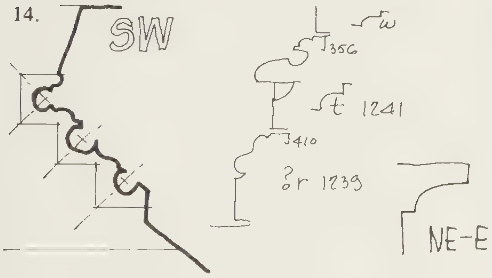
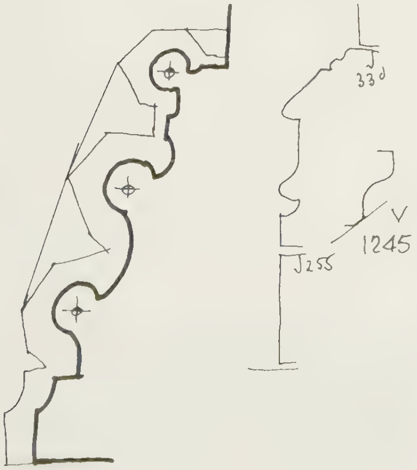


15. A few of these stones are replaced. The junctions with the older work show that they followed the original accurately. You can check with the photos in the Beaux Arts Box 2(6).



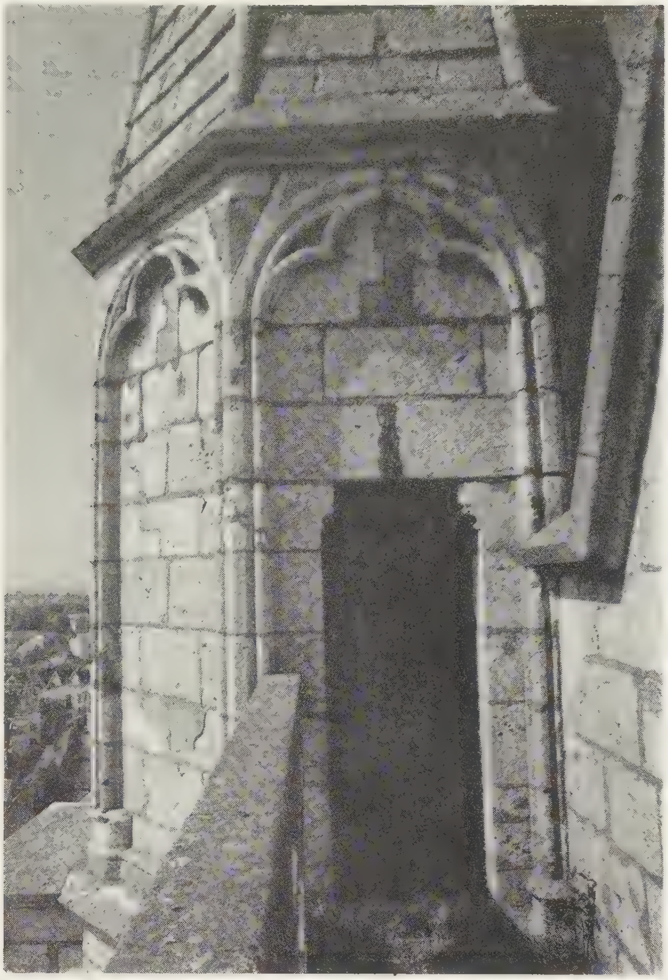
16. The different plans can be seen in n.13. See XX:42, for the location of the corbel by Lemon-w. See bottom left on page 510. This is the only time that Lemon worked on the job unless the old corbel out of the NE(t)-triforium door is his instead of Green's, which I doubt - XVII:13. In the towers this Lemon cannot be Green as the bases do not match any of his other work. His NE-E corbel is on the left.

17. The coursing shows that the plinth is probably Query-r whose damaged corbel lies on the north side of the SW-W door - XX:42 -and that Green-t laid the torus with his corbel on the other side of that door. His chamfered corners are typical. The lintel which was cut either with or after Green could be in any later campaign up to but not including Sapphire-x who built the columns on either side of the door - n.20. The change in the plan between the tori and the shafts over them is shown in n.14, and it marks the joint between Green-t and Lemon-w. I chose Lemon as I had to exclude Bronze and Damson, who would not have treated them in this way.

18. The joint in the SW steps down from the uppermost double tread. The rest of the treads are singles, as can be seen in XX:42. In the SE a similar joint can be followed from over Green's corbel by the gallery to below the tower bases. It is the same in the north, though the broken coursing is more complex in the NW around the niche.

The singles in the NE are uniform, being 195-200mm high, and with an evenly cut 80mm splay set at 45°. There are none like this in the other stairs, so they cannot be Sapphire or Lemon and so must be Damson just before the Decision. He retained the same diameter for the newel as the other masters. But in the NW the newel was reduced to 382mm, the singles are 213mm high. These dimensions relate to Sapphire's foot as 4/3 and 3/4 respectively. The splays are 55-60mm at 46°.

PHOTOS 532 & 533: The NW turret, and on the opposite page the SE.



PHOTOS 534 & 535: The SW turret on the left with Moccha's corbel and the start of the gables in the course with the trefoil arches. On the right the NW turret.

the door. They were to help support the future vaults. They are engaged in to the walls from the level of the torus upwards, but below that both the columns and their bases have been fixed over the face of the wall.

They occur in no other tower, and like the niche are therefore by someone who did little on the inside of the others. This has helped to sort out the order of the crews in these parts. Further their bases are very like those in the porch of the chapter house, and so I have given them to Sapphire-x.[20] This same Sapphire built the transept screens and began the walkway over it. The edge of the drip mould was continued round the towers by his successor who began the first of the turrets, and cancelled Lemon's scheme for the niche.[21] The Decision then came during the next program of Damson's.

At the top of the SW turret the octagon is capped with a cornice of heavy stones 720mm high. Round arches are carved into them with the inner edge of the roll-mould extended into a cusp. The entire arch is contained within the one course with the vertical joints passing through the centre of each side.

The SE turret is quite different. The arches are pointed and are cut from three courses instead of one. The inside cusping is also pointed and is formed from the wall moulding in quite a different way. Above the arches there is a cornice supporting a conical roof. The roll-mould over each hip of the roof finishes in a small torus and base integral with the cornice. But if you compare the photos you will see that the SW hip just butts into the cornice without any mouldings.

In the SW the cornice over the turrets sits directly over the round arches, and in the corners there are small

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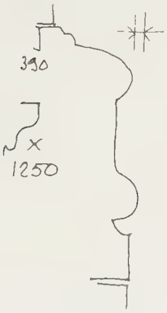
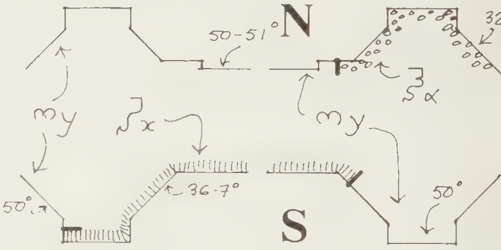
19. The niche was begun before the first of the turret bases, and so is before Damson-z, and before the screen which is Sapphire-x. Hence this master intended to cap all the stairs in a manner different to these towers, perhaps with a tall roof set over the lower and larger stair enclosure, without reducing it to the turrets Damson used. This is the work of Lemon-w with his tori nearby - n.13.

20. They are the same heavy shafts with the same octagonal section and torus set in from the face of the plinth, and possibly the same Punic foot of 283mm.



21. The paving is flat in the north, but in the south it is scooped out in the middle. The main differences are in the angles of the cornice splays, shown on the drawing. Some changes are obvious. The southern ones are rather like the paving over the bridge from the NE(t) walkway to the sacristy roof - XI:35, XVII:11 and n.32/i. Hence the south gallery paving is by Sapphire with the screen, the north will be by his successor Testikleys-y who also finished off the sides of the south. The NE was probably laid by Moccha-α, n.24/f. On the west side of the SW the cornice has been eased over to support the turret showing who placed it.

Over the bridge to the apsidal towers the paving is supported on two corbels, Damson and Sapphire, and the only time these masters occur in this order is in campaigns 'v' and 'x' - XX:39. Their work capped off these towers and, if we can deduce anything from the new roofs laid over them last century, in such a way that no further work could be done above that. These corbels seem to mark the point where the clergy decided not to continue with the towers, and to cap their stairs. It is interesting that this occurs only two campaigns before the Decision itself. perhaps they decided, under the pressures of finance, to omit the eastern spires first, and then after a further couple of campaigns, to cancel them all.



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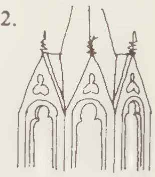
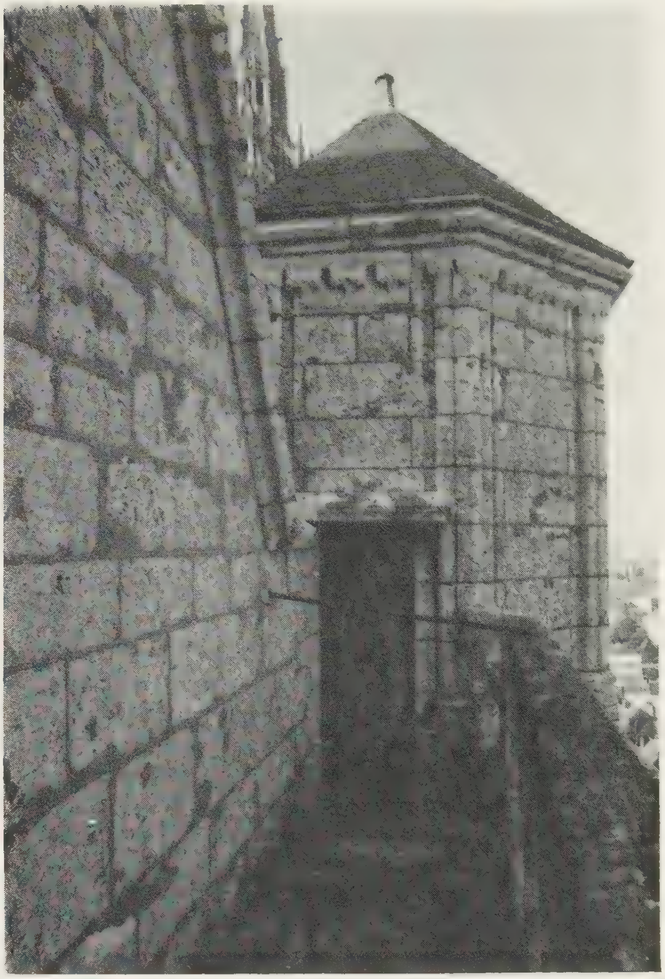


23. The SW spire is taller than the SE. Scaled from the south elevation in Lassus and Durand, 1842-65, their heights are 10,600mm and 9,150mm. The difference of 1,450mm is most obvious, and along with their cornices indicates that they were begun by different

triangular infills which square them off. They seem to be altering an earlier intention to finish the turret with eight pointed gables, perhaps like this.[22] The gables were left out in the next course clearly illustrating the joint between the masters. There is no attempt at gables in the SE, and its stones were cut for the same type of cornice as in the SW. The SE pointed arches with their sharp-edged cusping would therefore be the work of the master who began the SW roof and cancelled its gables. Also the different roofs and their different heights show that the master who began the SW spire did not begin the one opposite.[23]



Between the turrets lies the wall of the gable. It was butted into the SW turret, but was built integrally into the SE showing that the SE was advancing on its own. The coping over the gable with its fluttering leaf-buds was also butted into the SW, but was built into the SE, illustrating the same message. Now that the work around the turrets is clearer, examine the different designs begun for their bases.[24] The arrows show the differences in the design, one smooth and the other accented, one making the wall into a panel, while the other framed it. The bases underneath these pilasters are also different, one being one course high and the other three. Further the entire SE octagon has been twisted to the plane of the gable and it is smaller than the SW.[25] This seems to be the work of two crews.

However, there is a third: for on the south side of the SW turret the shape of the bases changes again, and this plan is identical to the one under the NW turret.[26] Five programs to build three courses is pretty slow. Since the first campaign in the SW is like that to the NW, and as

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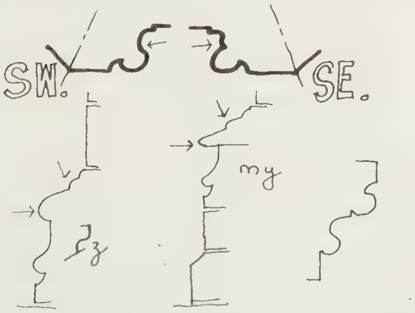
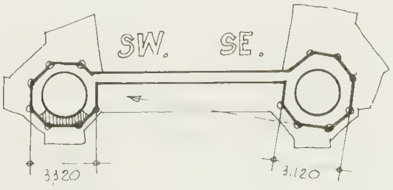
masters. But read n.27. I attribute the gabled arches of the SW to Cobalt coming after Moccha's corbels, the ones in the SE to Testikleys with the SW spire, and the SE spire to Sapphire-β This way they would have been finished around 1280 [1260].

24. None of the turret doors have corbels except the SW, which have two finely carved ones like Bronze's f. His work is so different to that of the old master's that I have called this team Moccha. This was the second campaign after the Decision.

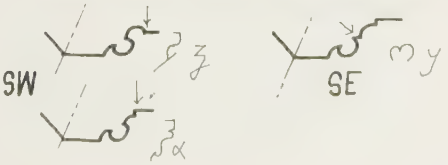


25. The octagon of the SW turret is formed from two squares each 3,320mm a side, and was determined by Sapphire-x whose few stones are shaded on the drawing. Testikleys followed. This square could have reduced to 11 Punic feet at the wall face. The SE turret by Testikleys is from a square of 3,120mm which, like the previous dimension, has been measured at the pavement level, though the geometry may not have begun here. In the north the NW measures 3,330mm and the NE 3,280 - n.12. The section through the SE has some resemblances to the window in the passage from the sacristy to the cathedral - n.32/b.



26. The corners of the turrets:

a. The details in the turrets do not differ by much, but when we combine the different octagon sizes with the different mouldings and bases we can see these were breaks in the work where shown. The same applies in the north, though the panels and their surrounding mouldings are similar, the small differences in the tori and the dimensions show that the NW was begun by Damson with his corbels and that Cobalt followed his arrangement but not his templates in the NE. Damson's design matches in section, plan and size his work in the SW turret.



b. In the NE Testikleys-γ did a 'cheap' job on the south side by omitting the recess of the wall panel and carving crude bases - or do we have another team in here who did the same in the west - n.31/j. Did he think it would not be seen here, even by God? Does this therefore show another change in medieval thinking, for it has been argued that the splendid carving placed where it cannot be seen was always done for God's sake, and not for man's?

c. There is a joint two courses below the turret cornice where the panel is re-introduced, and it then steps down on the west to below the gable coping, under the lintel, and then up again.

d. In the NW there is a canopy over the door, the only one, which is chopped into and so later than the coping. Behind on the south side there is a series of splayed slabs covering the back of the tower. Joints could be complex here.

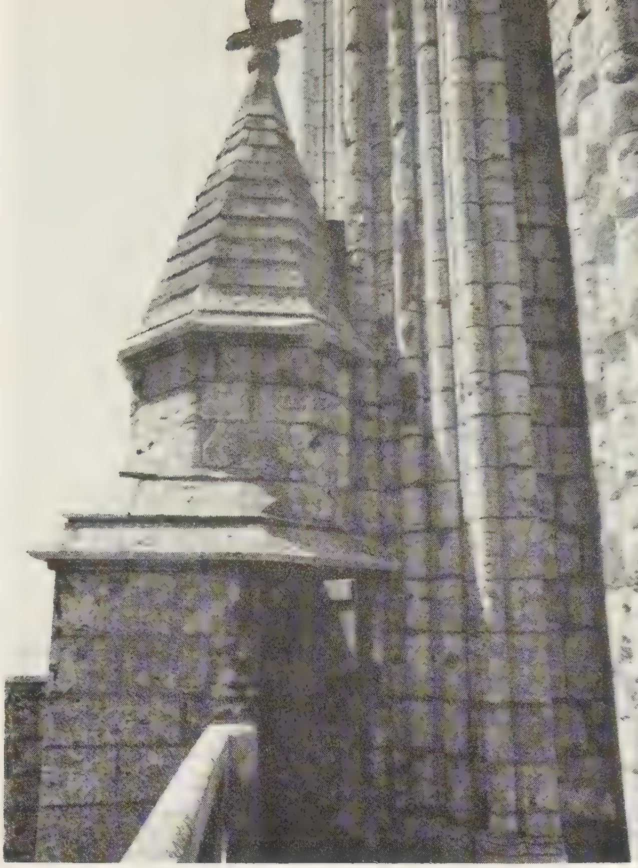
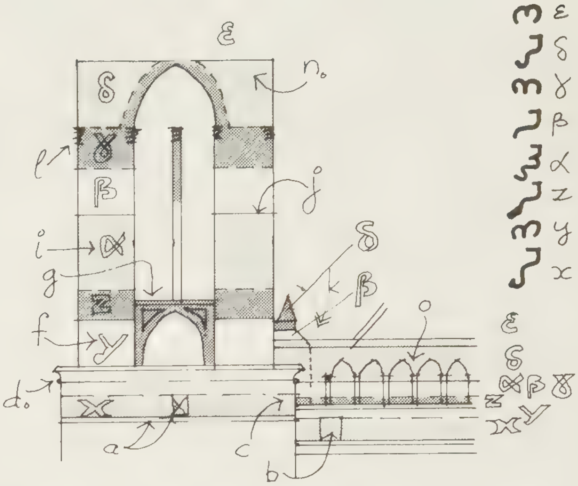


PHOTO 536: Turret over stairs to WN tower, set up by Testikleys and probably completed by Sapphire.

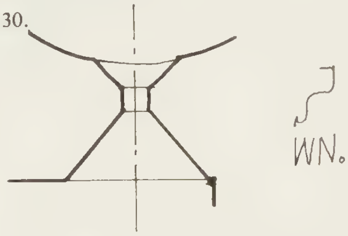


27. The only evidence is that the NE turret is 2,720mm high and the NW is 2,950 from the paving to the underside of the capitals. Perhaps these differences were deliberate for the SW is higher than the SE (3,412:3,120) being a proportion of about 11:10. Was this an optical device to compensate for the taller western end of the cathedral now that the transept spires had been cut out? Also the caps under the NW turret roof are those over the Kings in the west gable and so are by Sapphire - n.31/o. The northern turrets were therefore finished at the same time as those in the south.

28. See n.10 for the attributions, though some of them are inevitably a matter of convenience. The plan of the bases to the statue supports in the north are like the western strainer arch n.31/g, and so would be by Damson. Also the bases under the tabernacle are like his in the turrets. The dimensions are a mixture of the RF and the PM in widths and in heights only on the north side. The southern sections are the same but the dimensions differ. These tabernacles have been butted over the face of the gables, unlike the north where wall and tabernacle are built together. In n.5/c and e I link the arches over the tabernacles to Sapphire's work in the screen. The statues are built into the wall - except for the angels in the south. Most scholars think that they are fourteenth century, though Jean Villette would put them into the thirteenth. I would attribute them to Cobalt or Moccha, possibly between 1260 and 1270 [early 1250's]. The bracket figures match those under the arches of the sacristy bridge by Testikleys - n32/h. In the north the corbels under the figures are like Moccha's. His corbels may be seen over the turret door in PHOTO:534.

29. See the engraving by Chapuis reproduced in Mallion, 1964. It was done last century, probably before the fire.

30.



31. *Elevation of the WN tower from the west.* Lefevre-Pontalis (1905) observed that this stage of the WN tower was built between 1240 and 1260.

SAPPHIRE-x, 1250 [1247]

a. The spout is supported on an inclined Sapphire corbel. It is placed just over the twelfth century string course.
b. Another corbel on the inside of the stairs. The lintel may be by the next crew. The door on the south side of the gallery has the same curved arch he used later in the chapter house - n.44/c.
c. Continued the stairs behind the gallery to below the cornice with the windows n.30. Probably did the vault over the top room of the twelfth century tower - XI:2. There could be another crew in here.

TESTIKLEYS-y, 1254 [1248]

d. This is his cornice. There is a butt joint against all the walling of the Gallery of Kings on the south.
e. The cornice under the kings has just a drip mould, but it has the same section as 'c'. There is a joint near the north end.
f. Planned the tower with curves coming into the sides of the shaft mouldings and with bases like those he carved for the turrets.

DAMSON-z, 1258 [1250]

g. The strainer arch is set between the tower walls, with Damson's corbels. The piers use the same octagonal form found under the north tabernacle figures, and with the same mouldings.
h. Began the shafts around the kings. However they could have been delayed while the tower was being built, or work here could have been taken to the underside of the capitals which is level with the top of 'd'. It was then stopped, see 'o'.

MOCCHA-α, 1264 [1251]

i. Continued up to the omission of the panel in n.34.

COBALT-β, 1268 [1253]

j. Simplified the silhouette of the tower.
k. Placed his corbel over the top of the stairs ready for capping it off. This work is added over the face of the tower walls.

TESTIKLEYS-γ, 1272 [1254]

l. The caps, and presumably the arches over them.
m. Replaced one of the capitals in the WS tower, presumably damaged by fire. Also replaced some stones in the gables.

SAPPHIRE-δ, 1276 [1256]

n. Probably finished the tower and the spire? - VII:33.
o. He placed the last caps over the Gallery of Kings which have the cube-and-flame caps similar to his over the NW turret and the vaults to the sacristy. The joint is just under the caps as the scotia alongside the shaft is omitted. He arched over this with a pointed moulding like his over the transept tabernacles n.5/c. This walling is butted against the towers and the stairs 'k' showing it was later. He began the coping

the NW is associated with Damson's corbels and the top of the tower shafts, this marks the line of the Decision on both sides.[27]

Between the turrets large tabernacles have been built across the face of the gables. They enclose statues of the Virgin and a pair of angels. In the south the figures are supported on brackets, and on the north on pilasters. The figures carved under the brackets are like some in the sacristy, and the capitals and arches over them match other work in the area.[28] The gallery in front of them is screened with a balustrade. On the south and NW it butts into the turrets, but on the NE it was built in with it for a small nib projects from the corner to hold it. It was therefore by Cobalt. The one on the south is recent.[29]

It is amazing after the pace of work in the rest of the cathedral that these last few courses in the gables took over thirty years to complete [or fourteen by the shorter dating], from Bronze-u's hip roof in 1242 to Sapphire's last coping stones in the 1270's [1250's]. Truly they could have said with Elliot that "this is the way the world ends, not with a bang but a whimper." If the clergy had to take a full generation to just cap off the gigantic work of the previous two, they had certainly turned their attention to other things. Three of these things still stand: the chapter house, the sacristy and the uppermost parts of the WN tower. They are not large works, nor can they be compared collectively with the great building that lies between them. Nevertheless, being carefully designed and well crafted, they show that the Chapter was still demanding the best.

In the west the main cornice over the older part of the WN tower has twin bud crockets without further adornment, whose master I can only call Testikleys. I have none of his corbels, so cannot give him a colour. Behind the cornice is a small stair with two windows.[30] It ends in a turret, and alongside that is the massive wall of the next stage of the tower. This rises well above the western gable to merge into the highly decorated spire built in the sixteenth century. The join betwen the spire and the thirteenth century work can be seen where the delicate detailing begins and the plainer wall ends. The central opening has sixteenth century tracery at the top, but it rests within the sturdier architecture of the 1200's. Jean le Beauce simply took out the old tracery and replaced it with his own, and covered the join and the older arch with a facing of thin cusps. He therefore left the capitals under this arch and they, like the cornice below, are by Testikleys.[31]

This master not only worked twice here, but also twice in the sacristy.[32] He carved some of the capitals round

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over, but there is a joint through the middle of it. The upper part has no flames, so there is another master who laid the top of the coping and the gable with its fairly crude tabernacle.

p. The spire was a wooden one, and may have taken some time to complete. VII:33 [1259? - n.1].

From Levy, 1956 the present height of this spire from the ground floor plinth of the tower was (after adjustments for the seventeenth century bronze vase) 111,440mm. The height of the WS (after adjustments for a bit lost in the 1903 repairs) 103,680mm. Both heights are taken to the apex of the spire which lies within its decorative point. If we follow Crichlow's idea, 1973, that the sun and the moon must be represented in their heights as it is in their weathervanes, then the WS tower is 354 units of 292.8mm, and the WN should be 365¼ of these units high at 106,950mm which is about 4½ meters less than it is today. Today's height is Jean le Beauce's, as the original spire was lost in the storm, and it measures 365½ English feet. Was this his foot?

32. *Elevation of the sacristy, west side.*

a. There is a ripe confusion of corbels, bases and joints around the doors into the hall and the stairs. In one case Sapphire had cut his corbel in the same stone as a leaf which lies on a shape I might otherwise have given to Bronze. Other corbels here are Ruby, Bronze and Cobalt, and there are some Olive bases. This suggests that the lower parts of the sacristy were taken in hand around 1240.

b. The sacristy passage window has a simple section and no bases or capitals. Master may be Testikleys - n.25. For the door into the cathedral see n.39.

SAPPHIRE-x, 1250 [1247]

c. The main work on the building seems to begin here, and it is a large one including the treble-roll corbel under the stair soffit on the west side - n.37. This is shown dotted and from the height of the stair shows that he built a large part of the building, with most of the north wall.

TESTIKLEYS-y, 1254 [1248]

d. The slot windows in the stairs are not like Sapphire's in the WN tower.

DAMSON, BRONZE & COBALT

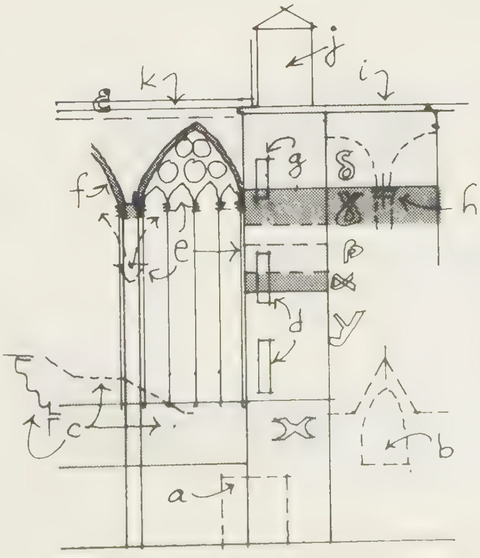
e. Four masters in a dozen courses, but including the bridge, the springing capitals and some of the window caps.

TESTIKLEYS-ϒ, 1272 [1254]

f. Some. window capitals and the upper tracery, and the arches ove them.

g. Repeats the window used earlier.

h. A pair of shafts rise on the east side of the bridge, and finish in a capital like his in the tabernacles - n.28.



SAPPHIRE-δ, 1276 [1256]

i. Scooped out paving over the bridge like the south gallery - n.21. It is supported on a corbel which is like his, but could be Testikleys? Note the support under the spout on the se. corner.

j. May have begun the turret, but the shafts have no brothers in other parts. The top is finished like the north turrets, with the caps finishing over a horizontal moulding shaped like a Sapphire corbel. Was this built while the vault was being set up? or was it more recent? It now forms part of the central heating, for the flue runs up this staircase - n.38.

TESTIKLEYS- ε, 1280 [1257]

k. Built the last course butting against the side of the roof rimbers, and against the back of the turret. However this building must be sudied more carefully against other contemporary buildings, for the cornice may have been built in campaign 'ϒ '.

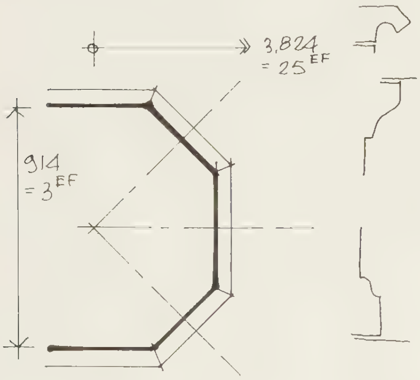
The whole of the stair tower may have been built to the top of the windows in one campaign, but the different leafage in some of the springing caps and some western caps suggest at least one other crew in between the second and third windows. The northern part of the sacristy could have been slower than the stairs, but if so we would still have to explain how the stonework over the first tracery window came to be bonded into the frame of the upper stair window. Perhaps the work began with Sapphire- rather than Sapphire-x, with an unknown crew working somewhere in the middle. If this final Testikleys was omitted the order of the crews would vary, but none of the dossiers would alter.

the windows and the cornice along the roof. Though he came twice in each place, his two campaigns were close together in the sacristy, but well separated in the west. In the latter he would have set out the tower, and was succeeded by the master of the strainer arch on the western face which butts into his work. The details and one of the corbels is characteristically Damson.[33] Above him the templet for the tower was altered, by eliminating the raised panels between the corner shafts[34] and it is well above that that we find the Testikleys capitals. There is also evidence for Cobalt over the stairs by the base of the tower, and for Sapphire in the arches over the kings.[35] Another campaign by Sapphire can be distinguished below Testikley's cornice,[36] so the order of crews is Sapphire-Testikleys - (Damson, Cobalt, Sapphire) -Testikleys where the order of the middle campaigns are uncertain.

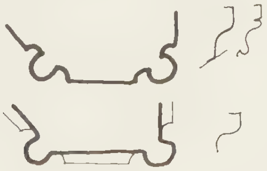
Returning to the sacristy Sapphire worked before either of the Testikleys in the sills and in the sloping passage on the eastern side,[37] and also between his campaigns on the top of the bridge joining the roof of the sacristy to the triforium walkway.[38] I would therefore guess that the Testikleys in the sacristy window tracery could be inserted after the unordered crews in the list above like this: Sapphire-Testikleys- (Damson,Cobalt) -Testikleys-Sapphire-Testikleys. This order suits the springing and the caps inside the sacristy, and the stairs and its windows outside.

When this sequence is placed alongside the gables we find that the first Sapphire built the screen and paving over the gallery, and that the last Sapphire completed the turrets. This shows that the last work on the gables was being finished with the roof and cornice of the sacristy and with the spire over the WN tower. From the crews in the gables we must add into the sacristy-WN sequence the work of Moccha in the SW turret, and the overall results,

[33] Damson's geometry uses the English foot - 305-6mm. See also his north tabernacle bases which have similar simple outlines. The strainer is butted into the tower walls and was built later to support the central mullion of the opening above it. On the right I have drawn the section through the cornice over the strainer, the corbel and the plinth.



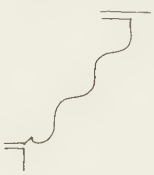
34.



[35] The stairs begun by Sapphire continued past his windows - n.30 - to the paving, and stop. They were finished with the turret by Cobalt with his corbel over the door. The conical roof over the stairs is let into the tower showing that the roof came later. The wall behind the kings is butted into all levels of the tower and the stairs, probably to leave the space around the tower free for scaffolding during construction, Sapphire added his caps over the recess - n.5. The kings in the gallery are more in the style of those over the south porch from 1200, than from this period. The 8th from the north stands on a base like Ruby's in the S.c embrasure figures with a lion. 11 others could be put over the south porch without the difference being noticed, and they are the same height. Assuredly most of them are the work of the first decade of the century, not the sixth or seventh. Where had they intended to put them? Over the north porch? See XVII:3.

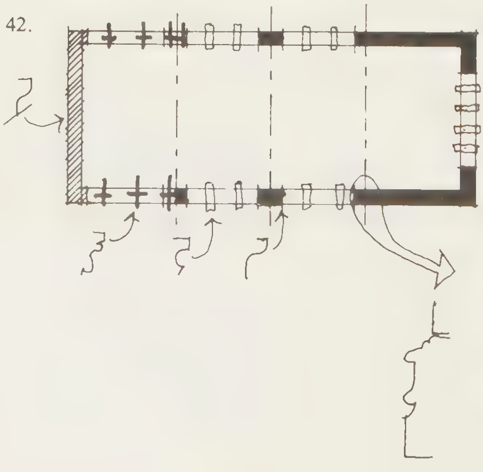
[36] See n.31/a-c.

[37] The soffit of the passage is supported on a continuous corbel, but it is cut with three mouldings instead of one. There is a similar corbel in the clerestory at Bonneval.



[38] The dished paving with his corbel under it - n.21. Also the turret has his bases, and the top of the turret is formed with a flat cornice as he used in the north - n.27. This could even have been built by him while he was master in the 1300's, as I suggest at the end of the chapter.

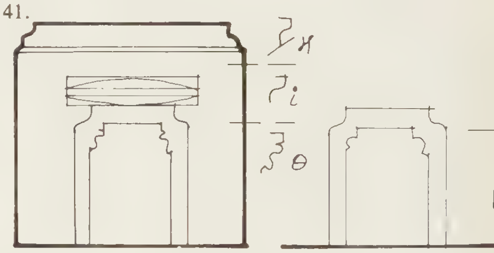
42.



[39] The door from the sacristy into the cathedral which had been built in the 1190's was enlarged at this time by Moccha for its bases are like his in the SW turret. The lintel is a bit battered, and is set rather crudely into the old wall, but its form is not unlike Cobalt's arches over the SW turret. Behind the lintel the work is supported on a Cobalt corbel. As the style of work is closer to their campaigns in the 1260's than the 1340's I would say that the door had been carved around 1266 [1252]. See van der Meulen, 1974 n.38.

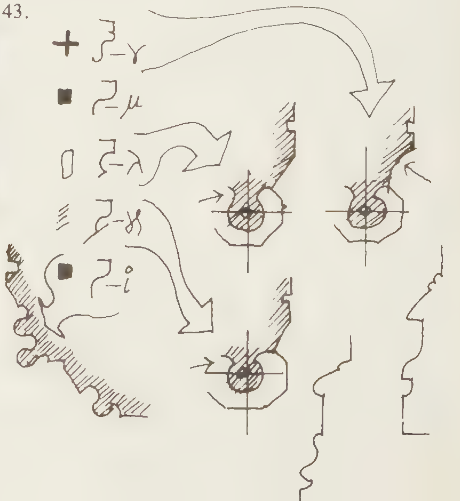
[40] See n.44/a.

41.



[42] It is not surprising to find the joint just over the door corbels and under the lintel, for this is the most common place for a break in the earlier work.

43.



which are very satisfactory to everyone's dossiers, are shown in the elevations. Moccha fits in best between Damson and Cobalt.[39]

The chapter house and the Chapel of St. Piat do not fit into this sequence unless its first crew is the last in the gables, for there are Sapphire corbels over the side doors into the lower floor.[40] Inside the upstairs chapel there are four doors on two levels into the circular towers at the eastern end. The lower doors have Moccha corbels just under the level of the window sills.[41] Just above that the inside of the door is reduced by Cobalt, and the top of the room is finished off by Damson. The corbels of the next door are by Lime with all the springing caps, followed again by Cobalt.[42] Both Cobalt corbels are linked to a curious bulbous moulding over the door like a stiffener in steel plate construction, showing it to be his, and not Moccha's or Lime's way of finishing over a door.

So the corbels give us five crews, and this is confirmed in the minor changes in the window mullions.[43] These indicate a definite tilt from east to west with a dip in the last bay. In the chapter house underneath there is a Sapphire corbel over one of the side doors, and this lies just under a joint which is more noticeable on the inside. The vaulting of the house springs out of the shafts without a capital, an advanced concept for the 1320's, and seems to have been built with the bridge from the cathedral and the nearby steps down from chapel IV. As there is a Moccha corbel over the door from the cathedral, and others under the bridge, I have linked this campaign with the other Moccha corbels inside the chapel into the one campaign. It is a big one and includes the plan for the upper floor, its bases and the walls around it. Assuming that Moccha did do this large campaign and that Sapphire was the first master without any others being hidden in the footings, the building is the work of seven masters like this.[44] Moccha's large campaign would

44. *South elevation of the chapter house and the Chapel of St. Piat.*
A chapter house had been built on this site with money donated by the deacon Adalart before he died in 1092. It survived the fire of 1194. See Merlet, 1906, p.223 and Lepinois and Merlet, iii, p.162. Its floor level was probably a little lower than the present one so the access to the cathedral had been "up and down" as discussed in n.45.

SAPPHIRE-η, 1316
a. Corbel over the door and beginning of the bridge.
b. Shaft bases like those to the columns on the inside of the NE turret - n.20. His layout of the bays inside is based on a perch of 25^{SF} of 284mm.
c. Simple splays for the sills. The joint is one or two courses above that and below it are the flat-arched lintels on the west.
d. Above the joint fluting is added to the columns, and the complex ribs emerge out of the shaft without the use of capitals.

MOCCHA-θ, 1323-
e. Corbels over the door from the cathedral, and under the arch of the bridge.
f. Same corbels over the doors at the eastern end of the chapel. The joint lies over this n.41. I have presumed from this that Moccha came after Sapphire and did a large campaign, though he need not have come here before the floor level of the chapel. This is the work inaugurated by the Chapter's order of 1323 - n.46.

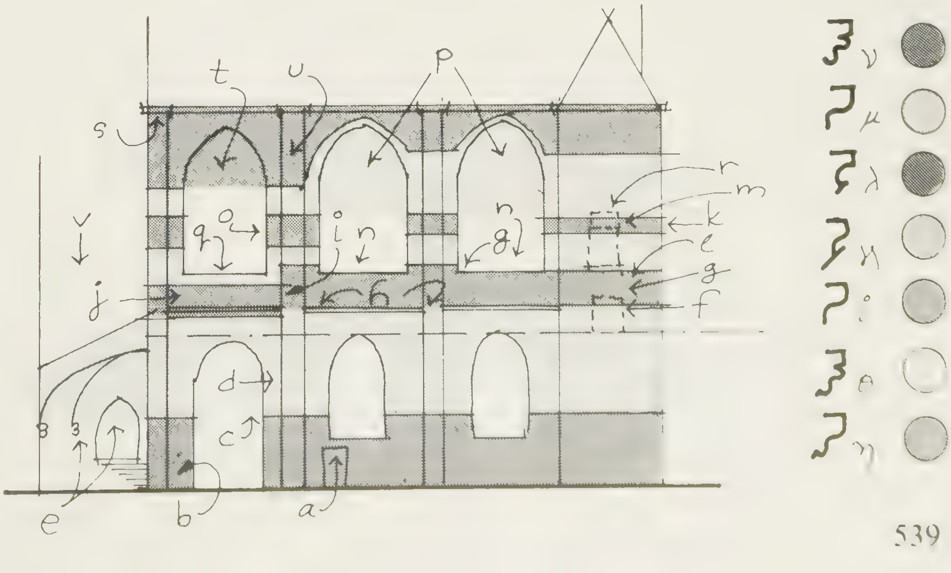
COBALT-i, 1335
g. Corbels and stiffeners over door. He began the sills and the jambs for the windows.
h. The outside buttresses are reduced by a simple splay in the east. Compare them to the west.
i. The shape of the jambs' bases are changed in the western bay - n.43, showing that the east was higher.

DAMSON-ζ, 1340
j. The outside of the western sill is simplified without a drip, like the sill under the lower windows, though the inside is constant. Does this suggest that Damson may have worked here after Sapphire and before Moccha perhaps completing the chapter house vaults? Notice that the outline of the chapel's wall shaft changes where it meets the wall in this bay.
k. The mullions in the eastern window are unlike any of the others and fit this campaign.
l. Corbel under the next floor level within the towers, n.41.

LIME-λ, 1345
m. Corbel over the upper door, slightly Green-like - n.42.
n. The mullions of the first two windows have a larger form than the others, and their bases are taller than the jambs - n.43. Some have the sharp angle over the plinth mould found in the plinths around the bottom of the chapter house - does this mean he could have set it out, placing Lime before Sapphire? Certainly not enough information.
o. This campaign included the springing caps all round.

COBALT-μ, 1350
p. Tracery to two central windows with the arch over it.
q. His mullions in the western pair of windows are more slender than the others, and have a curved edge next to the shaft which starts against the straight section of the sill, n.43. The torus is more pointed.
r. Corbel over the door carved with the wall and with it the start of the ribs of the vault.

MOCCHA-ϒ, 1352
s. Presumably he finished all the uppermost parts.
t. The west window caps have the same flat leaves found on the three eastern bosses, so the vaults are by him too, and would be after the roof, and therefore after the gable.
u. His corbels support the window arch, and from the buttress drip they were built with the western window. The arch over this window is not like the others.
v. The tracery of the entry stairs was butted into the wall, and could be by any of these masters, or later.



be after 1323, if I am reading the documents properly, and the last team, which seems to be Moccha again, would have finished work by the time of the dedication in 1358.[45]

This means that it took them thirty years or so to finish the upper floor of a room no larger than half the bays of the aisle along one side of the cathedral's nave. If the documents did not tell us it would be hard to believe they could be so slow after the speedy way they had built the cathedral itself.

As we now have quite a lot of documents to study I was interested to see if we could link the names mentioned in them with the masters in the building. The first one which refers to a master by name is dated 1276. He is Simon Dagon and he turns up again in another text forty years later.[46] Does this mean that he was the only master for that time? We must be wary of documents. Reference to a master does not necessarily mean that he was the mason-architect, for their terminology is often loose. He could be the administrator, the permanent maintenance man or a visiting master. The actual works may have been built and designed by some team not mentioned in the documents even though the cathedral was at the same time employing a full time master. This frustrating ambiguity makes identification difficult.

The three references to the one family of d'Ivry does not necessarily mean that they were in continuous residence, for they could have come and gone as did their predecessors in the thirteenth century. However, something may be gleaned from them, however uncertain. If Moccha began the stairs after the order of 1323, is he the Hughes d'Ivry recorded in the text? Hughes was succeeded by Jean d'Ivry who may have been his son. I guess that as the last master was Moccha this may be the son who was mentioned in 1352, and this would have given him five or six years in which to complete the vault and the roof before the building was dedicated.

But between the d'Ivry's campaigns there is unmistakable evidence for four other masters. I would therefore presume that Moccha-d'Ivry left the site at some stage and did not return until after 1350. Jean seems to have remained in Chartres, or perhaps returned again, for he retired there in 1382. He would by then have been quite an old man, and may have spent much of the last 25 years maintaining the Chapter's buildings in and around the cathedral close.

The only other master to come up twice is Simon Dagon. In 1316 he could have been the Sapphire who began the chapter house, and so in 1276 he would have been the last master in the sacristy and the WN tower.[47] His dates seem to fit the work quite nicely, and if Simon had become a permanent site architect in the last decades of the thirteenth century he could have begun the Chapter House at any time, and built it with a few men as slowly as he pleased, or as funds allowed. For certainly by now money for great religious works was less plentiful than it had ever been. The great booming days around 1200 were truly a thing of the past.

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[45] This is how other scholars have played with the dates of this building:

	chapter house	St. Piat
Delaporte, 1915-22,p.35-		-1324 - 1350/8
Jusselin, 1915,p.334	1324 -	
Mâle, 1948	1335	1344
Merlet, 1926,p.53	1323-35	
van der Meulen, '74,p.33	1324-	- 1358 -

The most important document for the theory I am propounding is the Chapter's decision in 1323 that "It is ordained that what shall be and be built or constructed concerning that (quoddam) new chapter house of stone shall be so high that it should be possible to go there from the church into the said chapter house without any descent or ascent." Lepinois and Merlet, 1862, p.4.

Two things must be noted here. Firstly the use of the word 'quoddam' could refer to a building being built, or to one already built, but not to one about to be built. Therefore in 1323 the chapter house had been started. Secondly they required a House the access to which did not 'descendu vel ascendu'. In a very interesting article van der Meulen, 1974, discusses this and suggests that its floor level was raised. If so then this order must refer to the first campaign in the chapter house. However, with about as much evidence as this at my disposal, I would suggest an alternative. This 'descent and ascent' may refer to the access from the cathedral which before the new stairs were built could only have passed through the dead-end passages. You have to climb up six treads into it, and then you would have had to descend many more to the floor of the old chapter house. The new stairs out of chapel IV would then have simplified this by descending, without any prior ascent. From the evidence at our disposal you can only take your pick. I would like to thank Vinzenz Sedlak for translating van der Meulen's article for me.

[46] Most of the documents are translated in Lepinois and Merlet, 1862-5, and other references are given in brackets. The documens were destroyed in a British air raid in 1944.

1276 -	Simon Dagon is named in evidence in 'le procès-verbal d'ouverture de la châsse' of St. Piat (Jusselin, 1915-22).
1300/1316 -	Jean de Carrières.
1316 -	Simon Dagon (Mely, 1920, p.301)
1316 -	Pierre de Chelles, etc, maintenance report (Branner, 1969).
1316/20 -	Berthault, Master of the Images (Mely, p.299).
1323 -	and afterwards, Hughes d'Ivry referring to his construction of the chapel of St. Piat, and to his successor Jean d'Ivry.
c.1350 -	Donation by Cardinal Aimeri de Châtelus.
1352 -	Jean d'Ivry signed 'le proces-verbal de visite de reliques de St. Piat' (Merlet, 1926).
1356 -	Jean Villette has a theory that the glass over the entry from the cathedral to the chapel was donated by Jean le Bon on his pilgrimage to Chartres that year. This would date that window.
1358 -	Consecration of the chapels.
1382 -	Jean d'Ivry relinquished his office as master (Merlet).

[47] In the shorter dating Sapphire's last campaign is placed twenty years earlier in 1256. In this case we cannot equate Sapphire with Dagon.

TWENTY TWO

The contractors

PHOTO 541: The interior of the fourteenth century Chapel of St. Piat.

Just as today there are great contracting firms that undertake to build a dam in Asia, a bridge in Africa, a hydro-electric generating plant in South America, so in time past there have had to be companies of some sort whose organisation, resources, equipment, experience and knowledgable personnel could make possible the most important building operations of the time. The Pont du Gard for Roman times, and the great French thirteenth century cathedrals for Gothic times commanded the most consummate skill and the most enlightened practices of the period.

James Fitchen

It is relatively easy to build something small or simple: the builder just needs a craftman's training and some knowledge of where to buy the right materials. The quality of stone and timber may vary from place to place, as may the availability and price of iron and lead, and as long as he understands what he can get from his own locality the small builder is in business. But the large structure is something special. Its requirements draw on the resources of a vast area that transcends regional boundaries, so that an appreciation of local labour and materials is less important than the contractor's "organisation, resources, equipment, experience and knowledgable personnel."[1] This is why the French mason William could be brought from Sens to work at Canterbury, and why German and French masters could be called in to advise on a cathedral in Milan.

The large contractor's most precious possession was the managerial skill of his men. He did not need a big staff for they did not have many of the specialist engineers and surveyors we use. A builder employing more than twenty men would have had to have some sort of accounting system even though the building funds were administered by the client. As few of his men could read or write he would have had to either do it himself or employ a clerk. Similarly he could not have prepared an estimate or a tender without taking out quantities, however rudimentary, and as they did not have quantity surveyors to do this work the master or his clerk would have had to do that too.

Sadly we do not possess any builder's account books for this period, but only those of the clients who were on the whole paying labour by the day. Nevertheless you cannot spend $300,000 of our money each month without a few full-time clerks to keep track of the funds, check the tallies and make the actual day to day payments. If the master had been compelled to do all these tasks himself he would not have done any of them well, nor would he have had the time to acquire those social graces or to make those contacts which were to raise him to the high status he enjoyed.

The contractors of the middle ages had no engineers or architects in our sense of advisory professions separate and distinct from the builder. The mason's techniques for design - his geometry and his rules of thumb - were at the

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1. J. Fitchen, 1961, p.38. The comments which follow stem from my work on the cathedral and the careful studies made by many scholars on documents from all over Europe, especially Andrews, Aubert, Branner, Collombier, Harvey, Knoop and Jones, Salzman and Shelby.

same time the basis of his structural knowledge and his aesthetic ideals. However, the fact that he employed draughtsmen showed that he had men to help him realise the complex problems of determining where each element was to be placed, how large it was to be and how each stone was to be shaped.

To get a clearer picture of the builder's role let us look at the work of Red in 1213, and examine some of the decisions he had to make. He had never worked at Chartres before, and as one of the later builders there were few fundamental decisions left for him to make as they had been determined in earlier campaigns. Some of them could have been passed on to deputies, but any of us who have had experience in leading large and complex operations know that no master could have discarded all of his responsibilities. Every difficult problem would end up on his desk, every crisis be referred to him pesonally, and no matter how competent his assistants the man with the final responsibility could never absent himself from the day to day counsels which form the major chore of all leading roles.

On arrival he probably deputised his master quarrier with the task of visiting the quarry to find the best available stone. While there he would have arranged accommodation for the men nearby, obtained transport, and I fear was often compelled to repair the road from Berchere to the cathedral. In the end Red would still have to give his personal approval for the final face, for only he would know how the new work would be designed. Similarly in the town he would have deputised someone, no doubt after talking with the clergy, to arrange the accommodation there, the covered workshops with warmth and protection if it was winter, wood, iron and lead and all the other paraphenalia of a large *chantier*.

Meanwhile he would carefully examine the whole building which on his arrival would have looked as I have drawn it in Isometric-S on page 420. Most of the plinths for the flyers had been placed and in the nave the clerestory windows had been begun. In the choir the work was lower and the arches were still being set up over the triforium arcade. If he had got as high as the walkway in the east he would have had to make some fundamental decisions on the shape of the windows and the height of its sill, but his campaign was to be a small one and these decisions were to be left to his successor. In the rooms under the southern towers the walls were only half way up, and all he had to do was to follow the work of his predecessors at the same snail-like pace as before. In the north there was a gaping hole around the N.w doorway which had to be filled in as rapidly as possibly, and in the east his most pressing task was to determine the form of the access stairs and the walls and roofs nearby. Important as these decisions were, there were not so many that they could not be resolved over the months he spent in Chartres.

To get things moving while he thought over these problems Red could have immediately ordered the master carpenter to check the stability of all the woodwork left over from earlier campaigns, and the strength of the scaffolding round the job. He could also have instructed the carpenter to make additional forms under repeatable items like the triforium arches, as well as setting up the staging for the wall layers. He would have carefully examined the four giant cranes and the many smaller ones, checked the ropes and tackle, greased the bearings and replaced any faulty parts. In the east the cranes were probably raised and much new scaffolding set up to give access to the top of the triforium passageways and to get above the surrounding roofs. Certainly there was a lot for the carpenters to do. They had to find the right trees, chop them down, square the wood and bring it to the site, find twine and nails, make planks and dowells, and indeed set about manufacturing for themselves all the items we today would buy from the hardware store or the timber merchant.

Meanwhile Red would have begun the most important and personal work of designing the templets to be used by the masons. If all his men had arrived on the site with him Red could have given them something to do straight away by having them split and square blocks at the quarry. Meanwhile the carpenters could have been cutting templets for those repetitive parts where all they had to do was to place their timber over the top of the pier or wall to obtain the true shape. This could have included for example the voussoires for the unfinished arches around the choir triforium, and blocks for the nave buttresses and the walls of the southern rooms. Not much work, but enough to keep the men going while the master got himself organised.

Wherever Red had something to design he would have employed the same procedures: study the existing work and measure it exactly, then by drawing or by models decide how to apply his foot measure, his rules of thumb and his personal geometry to the problem. No doubt his foremen and their assistants could help to make the measurements, and his draughtsmen could draw up the results. No doubt they would have helped to draw the final planchette onto vellum or plaster from which the templets would be designed, and to check that the masons understood their instruction and cut the stones properly. But overseeing all of this, coordinating the many foremen under him and liaising with the client would still have adequately filled his time. Spending $12,000 a day mainly on wages demanded a lot of checking if mistakes were not to spread chaos and confusion over the site. Today we place one senior hand in charge of five to ten men, plus extra foremen where there are many gangs. Red would have had a permanent administrative staff of perhaps twenty cadres, and though only a few of them would have been purely desk men working away from the site or quarry, each had to fully understand the work he was to do so he could instruct the men and check their work on completion.[2]

Therefore Red's major task as Master of the Works was to visualise what was to be done, to determine the method and then to organise the teams so that his intentions would be carried out. This has been the indispensable task of the architect/builder at all times. Be he Roman or Feudal, capitalist or socialist the demands of a great edifice would have imposed the same disciplines. The ways of organising a large body of men to a constructive purpose with the maximum efficiency and the minimum of waste are much the same in any age and for any task. It is not for nothing that Fitchen placed organisation first among the attributes of the great contracting firms.

To pass precise yet easily understood instructions down to as many men as he employed is a most exacting and frustrating task. From the Pharaohs onwards men have had the opportunity to meditate on the problem and to find solutions, and from the first there is evidence for only one which worked: a visual two dimensional description in various scales of each part and its relation to the whole. The process today is from sketch drawings, to model, to working drawings and details to shop drawings. The evidence shows that in documentation as in most other aspects of the trade little has changed in eight centuries. Start with the most important instructions like those from the foreman to the individual craftsman for the roof slab described in chapter XII.[3] The stonework on either side of the windows under the slab is already in place. It has to span across them linking both sides together. When in place every corner and recess must line up with those below. More difficult yet, the master required a recess in the underside of the stone so that the window shutters might swing freely and close against a rebate under the head. He also wanted to put a pair of decorative gables over the slab, upstands for which had to be started on the top.

There is only one way to have such a stone carved accurately, be it done at the quarry or on the site: the mason must be given full-sized templets, cut from wood, which would show each face and curve. The recesses for the shutters would have been marked on another piece of wood, and separately again the location of the upstands and the section for the rebates around the edges. Three, possibly four templets for the one piece of stone. "The documents leave no doubt that by far the greatest number of templets were made out of thin panels of wainscote oak. These were planed thin and smooth, the profile of the block and its mouldings carefully drawn on, and then cut out exactly to the line. Throughout the period it was the master in person who drew the profiles, and they were therefore comparable to a painter's brush strokes as a signature of individual style."[4] The shape of the templet implies all the master's training and experience, the rules he prefers and the thinking which lay behind them. The templets are therefore the key to unlocking the master's identity.

To locate the plinths for the perimeter buttresses which were to support the flyers Red had to measure the section of an entire typical bay including the heights from the floor to the walkway. He also had to work out where he would locate the springing if he stayed on the job long enough. From these he would have made a scale drawing to visualise the problem. As different geometry is used in each campaign the masters would have had to make their measurements and their calculations afresh. No doubt they had shortcuts which speeded up the process and eliminated redundant or unnecessary steps, but no matter how simplified the techniques the newly arrived master had to repeat a part of the design process each time. Within the practical limitations of a building job this can only be done in two dimensions, be it by templet or by incisions in plaster or parchment, be it full size or to a smaller scale. If there were models they were for conceptual and didactic purposes as the intricacies of the geometry they used cannot be evolved in carved or solid forms.

There is no way in which the masters could have thought out or applied their geometric techniques without planning on paper, accurately and to scale. The consequences have to be discovered and resolved before they could be set out. A good designer can keep a large number of factors in his head at the one time, but if he cannot progressively set down his conclusions as he proceeds he will become more and more confused as the job becomes bigger and more complex. Many drawings have survived from the later middle ages, but sadly the earliest are the Reims Palimpsest collection of about 1250.[5] They all show the superimposed grid of lines which originate from geometry, and from which the parts are determined. In the Reims elevations all the major elements like pinnacles and cornices are drawn in long straight lines which carry right across the facade, even though they may in fact be interrupted by other elements.

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2. Perhaps I have underestimated the numbers at Chartres, and if so the problem is complicated rather than simplified. But working on an average construction team of 250 men I would estimate that these would include 6 or 7 gangs of skilled masons each under their own foreman, and perhaps another 50 men at the quarry led by a foreman and three senior hands. Perhaps a third of the men at the quarry would have been local. All the carting would have been done by locals employing up to fifty wagons at the one time. Most of the laying gangs would have been local too, laying 250 stones maximum each day, and this would have required another 50 men under a couple of foremen, and perhaps 20 or so loading and unloading and working the cranes. A dozen foremen and leading hands would be needed, plus those to lead the carpenters, plumbers and other trades. As well the master would have had an office staff of 2 or 3. If we extract the local men from this lot, the core of the team would have numbered about one hundred. See further discussion in ch.V, XI:10 and XIII:33 and text.

3. This is the drawing in XII:37 on page 261.

4. Harvey, 1972, p.118.

5. The earliest designs known are incised into the stonework of existing churches, like the two engraved on the walls of the abbeys of Byland and Jervaulx c1180 to be published by Peter Ferguson, and the later redesign of the Chartres west rose on the aisle wall at St. Quentin, mentioned in XX:25. See also Branner, 1958, Bucher, 1968, Harvey, 1972. The latter writes on p. 102 that drawings did not survive because they were made on board or on plaster, and that "once used they were smeared over, and the surface used again for a fresh job. The other reason goes much deeper: it is that of craft secrecy. This has nothing to do with the esoteric secrecy of mystical cults, though the two forms of secrecy may co-exist as in Freemasonry. It is secrecy of exactly the same kind that is practiced in industry today ... In spite of the popularity since the sixteenth century, of pattern books and technical manuals it is noticeable again and again, that the *precise* methods are left vague."

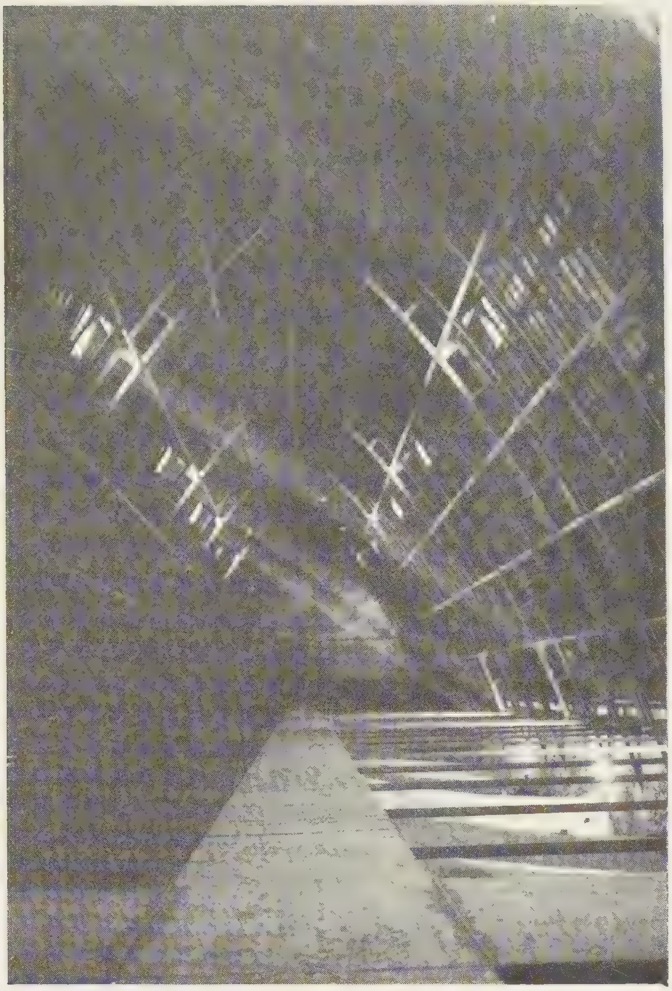

PHOTO 544: The cast iron roof was the largest yet erected in France. Now the home of a multitude of pigeons, it remains a most magestic space.

The use of continuous lines show they are determined from the geometric system, and are marked on the drawing to guide the master on the job.

If any of these sheets of vellum had been used as construction documents they would not have survived. A working drawing used on the site is fingered by many men many times a day, it is splashed with cement, covered with lime and morning tea, rubbed, doodled on, soaked by the rain and dropped in the mud. By the end of the job the drawings are usually a sad pile of tattered pulp ready for the bin. Few medieval site drawings would have had better treatment, and I am not surprised none have survived. Indeed, I am inclined to think that the only reason the Reims Palimpsests are with us is that they were drawn to show the client what the elevation would have looked like, and so they were never used on the job.[6]

I am sure that models were also used, though none have survived. Giotto was reported to have made a model for his campanile in Florence in the 1330's, as did Brunelleschi, Michelangelo, Sangallo and many of the other well-publicised Renaissance figures. But just as Brunelleschi used medieval building methods in the construction of the Santa Maria dome, and was content to cover its traditional material with an applied layer of alien decoration, so we should expect him to have used medieval communicative techniques. Similarly Christopher Wren was a prolific model maker, which included many specialised ones to guide his craftsmen in the details of organ lofts and towers.[7] In an age when few men could read and even fewer could understand a drawing this method was sensible and clear. Geometry can only be studied on paper, but massing and the play of light and shade are best studied, even today, in a three dimensional model. Indeed I know few laymen, even the well educated ones, who can properly read a plan in spite of drawings and maps being constantly used in all forms of media. Eight hundred years ago almost no one could have visualised what a building was going to look like just from the drawings. Models were indispensable. Further, a model can be displayed to the faithful to arouse their passion and generosity.

It may help us to understand the role of the model if we compare the two transept fronts. Superficially they are very different, for the south seems taller because of the thin colonnettes which encase it, while the north has a severer simplicity, and nothing has been applied to verticalise it. Yet behind the differences in surface the essential form of the two fronts are remarkably similar. Each has two towers of three floors encasing triple porches and roses resting over five lancets. All four towers are articulated by only a few shafts and the buttresses predominate. The openings are reduced with the gusset arches half-way up, and each tower is capped with a seven-ribbed vault. On both sides the triforium cornices are unadorned, the eastern walls have passages while there is a heavy projecting arch on the west. In basics they are almost identical.

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[6] These are presentation drawings, or what Bucher calls 'show drawings'.

[7] See Shelby, 1964, p.391, and Stephen Murray "the Gothic Facade Drawings in the 'Reims Palimpsest'", *Gesta,* 1978, p.51-5.

[8] Wilton-Ely, 1964. This scale is 4′ to the inch. or 3′ to the digit. The model maker would have needed a set of drawings to work to. See Frankl, 1945 and Harvey, 1972. Sangallo's model of St. Peters was to a scale of 1:24, and Wren's of St. Pauls was 1:18. These are very large models indeed. Even at the scale of 1:48 the Chartres model would have measured 2.7m. long by 2.4m. high.

[9] Note the exceptional action taken in the later middle ages to obtain plans from dying or retired masters - Harvey, 1950, 1972, Bucher,1968.

[10] Harvey, 1972, p. 81 and 104.

[11] The N.II and III bays were erected in 1237/8 to precisely the same arrangement as the first ones of 1219 - XVIII:5.

[12] Starting with Bronze's changes in 1195 and continuing to Rose-K over the walkway. Follow references in isometrics, GEOMS:VIII-A and X-C.

[13] GEOM:XVIII-E

The major differences between them come from using colonnettes on one and aedicules on the other, and from the more open design around the north rose. Though the details reflect the differences between the masters the similarities seem to indicate a common source, and are just those which would be most readily depicted on a small scale model of 1:48 or thereabouts.[8] As McLuhan said the medium is the message: the nature of their similarities comes from the limitations of the communication used. I would imagine that the model was made by 1195, and that it would have shown the inside as well and all the towers and their spires. Contracts with the masters may have included the common medieval injunction that the "new work should be like the model". In the broadest terms, as long as the masters followed the general outline set out in the model they were allowed to plan the rest of the work and their templets to please themselves.

The fact that each master used his personal measure and geometric methods to alter earlier work shows that previous contractors had not left their drawing behind them to explain the way they had planned it. Similarly the fact that each master produced his own details, even in plinths and window sills, shows that none of the templets were left behind either. Not that the majority of them would have been any use on another job, but they ensured him some sort of copyright. In the modern specification we always state that the plans remain the possesion of the architect, as being the only legal and practical right we possess over our creative ideas. Release them to the client and we become redundant. Withold them and society's future need for our services is guaranteed.[9]

The endless mass of trivial misalignments and errors throughout the length and breadth of the cathedral are further mute witness to the lack of continuity in the direction of the work. To highlight this fact I only need to remind you of the variety of windows and doors out of the circular stairs, the different types of window sills and jambs in the aisles and clerestory, the chaotic changes and twists in some of the buttresses, the miscut transept flyer spokes and the five different tower plans. And more fundamentally think of the changes made in each campaign to the axes and the arrangement of the parts around them, the different external elevations and the totally opposed methods for treating the upper parts of the nave, the south transept and the choir. Indeed, seldom in the history of art has such a palpably great building been assembled out of such discordant elements.

The ultimate responsibility for the control or coordination of any job rests either with the architect or with the client. At Chartres if the client had exercised even a little more than superficial control over the contractors he would have acquired a deeper knowledge of his building, and would have accepted the necessity of keeping them informed about what had gone before. The fact that he did not do this shows that he was at best an educated layman who was more concerned with the accounts than with geometry, and was prepared to leave all the intricacies of the building to specialists. Harvey has shown that this was not unusual. Out of a total of some 1200 identifiable English architects of the middle ages only eighteen could have possibly been clerics. This is why "the literary sources for that period, compiled almost entirely by clerics, are so uninformative as to architectural methods, however much detail they might give as to the history of the particular building works and architects; the clerks could not tell us the answers because they did not know them themselves."[10]

The only place in which the clergy seem to have exercised any design control, presumably apart from their initial approval of the plan and the later decision to alter the apse, was in the interior elevation. We are lucky not to have ended up with a Blois, a St. Pierre or an Orbais where the elevation changes in each section. The clergy at Chartres did exercise their authority to maintain a uniform interior as at Laon and Reims, even though they then let the masters modify the final shape of the templets as they went along. It is as if a large model was built for the interior, especially the clerestory windows, and everyone was specifically directed to follow it. This model may have dated from Ruby's campaign in 1211, and its scheme was imposed so consistently on all-comers that even in the last bays of the north transept dating from the late 1230's the builders were being compelled to repeat the now dreadfully old-fashioned plate tracery of the clerestory roses.[11] In contrast the client imposed no conditions outside, which is where most of the clues to the many contractors are to be found. Besides the endless minor alterations to almost every moulding, each master without exception altered some feature in the cathedral. These changes fall into three categories:

There are firstly those hidden behind dimensions, proportions and axes which were only understood by the contractors. Some have had only a minor if disturbing impact on the building, such as the differing centres and dimensions to the buttresses of the sanctuary at the level of the aisle walkways.[12] Others have profoundly affected the building like the meter or more that lies between the height Scarlet would have made the vaults compared to where Bronze actually placed them. We have precise evidence that the height of these vaults was intended at one level in 1215, and was set to another when Bronze began the lancet window arches two years later.[13] Here is one definite spot in which a major decision could only have been made by the builder, and where two masters were quite opposed in their ideas.

If someone other than Bronze had located the aisle capitals, would they too have been set at a different level?[14] Since everyone after him continued the level he had set there is no way of knowing, and within small limits a different height would not have greatly altered the appearance of the interior. But an extended elevation as at Cluny or Longpont would have completely distorted the present arrangement and given us another. Even the personal attachment to different foot units has contributed to the variety of solutions adopted. I believe that, without exception, all these decisions on dimensions and proportions were made by the builder without recourse to the client. How else could we explain the changes to the centres, the axes and to the proportions of the crossing made during the first four campaigns?[15]

There are secondly those very obvious changes to the arrangement and function of the building to which the clergy must have been a party. The doubling of the ambulatory around the apse, the elimination of the crossing tower and the iconography of the porches are obvious examples.[16] The Chapter must have been involved in the creation of the first plan, but to what extent? I am inclined to think that the centralised arrangement set around a crossing with four projecting arms, and the numbers used in the bays and chapels were all theirs, and little else, save of course the final approval of the model with its three tiered elevation, flying buttresses and possibly nine towers.[17] The subsequent unchecked dismemberment of Scarlet's geometry, bay sizes and bent axes suggest that the clergy had not involved themselves in these items.

If a competition had been held for the clerestory the Chapter would certainly have been involved, not as the designer, but as a participant in the decision to hold the competition, and in the final selection of the successful scheme.[18] But what of the design of the triforium? There is no way of telling whether this was part of the 1194 model, of an earlier competition or Ruby's own design in 1206. And in each case, who decided that the nave triforium should have five shafts per bay and the choir six?[19] The extent of the client's role in this and in many similar cases is impossible to determine, but as this history shows, it was generally less than has been assumed, not more.

There are thirdly those changes of a major nature which have most profoundly affected the appearance of the cathedral. Many can be shown to have been indubitably determined by the builder, and only the builder. If at this distance we can see that his scope for independent action extended to these major items, how much further could it have extended? It suggests that the role of the client may have been much less than we would today like to expect, and therefore that the role of the master was considerably enhanced.

And consequently, if the master could act on his own to this extent, what was there to stop him from creating nearly everything in the building as he wanted to, even though his term in control was transitory in the extreme? Clearly the line that separated the control of the client from that of the builder was a fluid one. Since only the client possessed and could over a long term impose on the many contractors the scheme embodied in the first plan and model, the absence of this control shows that both his interest and his experience was limited.

Where the client's influence was weak, the master's was inevitably stronger. With this in mind, let us follow the consequences through a few examples.

Whatever role Scarlet played in the initial months after the fire, the impact of these early decisions more profoundly affected the final building than any other. The narrowing of the eastern buttresses and the distortion of the axes by the second master began the process which led in time to the many dissimilarities at all levels between the nave and the choir. When Rose and Olive continued to modify the pier and crossing axes they added to the confusion their successors were to inherit. Thus the lack of client supervision over the first few years ensured much of the disunity that would follow.

Bronze laid out the piers of the north porch at the same time as he was designing the doorways in both transepts, 1198. Two years later Scarlet began the piers of the completely different south porch.[20] The only way I could imagine the client being knowingly a party to this would be if one porch was the responsibility of the Chapter, and the other of the Bishop.[21] But if the client could divide up the responsibility for the building design among its own factions, they could not have had much sense for the unity of the whole.

In 1199 Ruby built the sills in the nave and began the single windows there. He intended to repeat these sills in the east. In the very next year this was scrapped in favour of a walkway.[22] As Ruby had extended the first course of the sills into the sanctuary, the change could not have come from functional or symbolic requirements at each end of the cathedral. If the clergy had just changed their mind, who had stimulated them to do so? Was it Scarlet, for it is curious that the first stone he laid in the sanctuary embodied this new design.

The walkway would have been shown on the model, for that was Scarlet's too, so who had decided to build the sloping sills in the nave? Had Ruby convinced the Chapter that a sill was better, and had Scarlet then made them change their mind again? Such vacillations are hard to believe, and so I feel convinced that these decisions were taken by the master, on his own responsibility and without consultation with the client. This being so, what of the double windows in the sanctuary after the single ones in the nave? and all the other many changes?

In 1207 Ruby began the heavy buttresses over the nave triforium and prepared for the colonnetted scheme he established in the south in 1211. In the next years Cobalt and others cut them out where they could.[23] In 1215 Scarlet began the recesses for the ostiums in the nave, and in the next year Ruby created the quite contrary scheme of aedicules in the choir.[24] Who was running the job while all this was going on? On the inside these masters were being compelled to follow a given arrangement, but outside they had been left to their own devices. It was the same with the flyers, the different plans for five of the six towers, the upper works on the porches, the innumerable roofs around the triforium, and so on.[25] The arguments given for the aisle sills apply to all of these, and more.

What is the possibility that one master or another might have taken temporary control for a number of years even when his men were not physically present on the job? Bronze is the most obvious choice around 1200 and while the high vaults were being put up, and Ruby during the time the triforium was being built.[26] Yet in trying to define dates during which they would have had control, even over only the most important decisions, I find myself in conflict in every period with decisions made by others. The real picture seems to be that whichever master had possession of the site made every important decision on the outside his own way.

The overall situation is neither clear nor simple. There is no clear demarcation between the roles and responsibilities of client and builder as there is today. Iconography is certainly the Chapter's and geometry the builders preserve, but in between there is a grey zone in which we can distinguish only two ways in which the total freedom possible to the builder was restricted.

In the first he is compelled to follow some predetermined format, as in the clerestories between 1211 and 1240. However he was still free to dimension it as he wished, lay the stonework to suit his own structural principles and to employ his own detailing. We cannot say how much detail was shown on this or any other model or drawing, but it could not be much for so many elements seemed to be allowed to lead a life of their own. All we can say is that there was some measure of client control over some parts of the works some of the time, but that it was never very extensive.

Secondly there are items where one builder accepted and followed a program which had been begun before him, such as the heights of the arcade capitals, the templets used for the arches, the general arrangement of the triforium passage arches and bridges, and many others. These are unitary elements within the building, where once an idea is introduced it would be continued by all masters, with very few exceptions. The use of rosettes under the drip moulds, the impost placed over all capitals, and the similar templets used for the arches in each zone are small examples of the same thing.[27] The various examples of symmetry in earlier chapters show a similar thinking.[28] These are some of the places where the contractor followed the work his brethren had left, and often with improvisations. Every step in their designs was stimualted by and sympathetically based on what had gone on before. Almost every geometry in the book illustrates this essential and unvarying attitude.

Beyond these two types of restrictions the masters pleased themselves, and themselves alone, irrespective of what the client may have thought or of any plan the first master may have bequeathed them. The occasions when his egocentric and lonely authority imposed a personal will upon the construction are so numerous that we cannot find any restrictions placed over the builders

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14. XI:5 & 19, and GEOM:XI-A.

15. GEOM:VIII-A.

16. XI for the doubling of the ambulatory. XIX for the crossing tower and XVI for the iconography.

17. Discussed at the end of VIII.

18. See text around XVIII:14 and ISOM-R.

19. XII:32.

20. GEOM:III-E and XVI-A.

21. Or any other group among the Chartrain clergy. The 1224 document quoted in XVI:4 suggests that the dean received the dues from the south porch. In contrast the quotation from Lincoln in XX:18 suggests that the south rose was the Bishops and the north the deans. Does the sculpture reflect this, with the Judgement and the Second Covenant on the south?

22. VI:52 etc.

23. ISOM-R and XIII:6. Plinths in XII:10.

24. XVIII and XIII.

25. See geometries of towers in XIV, the porches in X:56 and XVI:38, and XII:38 for the roofs. See XVIII:75 for a list of the major changes by the builders.

26. Bronze in the doorways and the double windows in the sanctuary, and the aisle capitals 1198 and 1201. But what of Scarlet's south porch piers in 1200 and the altered windows and sculpture in the south? Again when we look at Bronze between 1217 and 1222, the only item completely under his control was the height in the vaults. Similarly with Ruby's triforium where in M and R he established much of this zone, while in between everyone modified what he had done.

27. Rosettes and rollmoulds together are first used over the sanctuary windows in X:43, and thereafter are used over all the clerestory windows except at the very end of the job -probably a Bronze idea. The impost was simpler in Ruby's capitals in the eastern chapel passages, IX:20 but was made more complex by Bronze over the arcade caps in XI:6. This latter moulding was then used throughout, save for some of the last caps in the towers - XX:37. The arcade arches begun by Ruby were reused in the high vaults. Scarlet's triforium arches were reused in the vault ribs - XVIII:47 and XX:37. Plinths may be another unitary item, for below the towers nearly all of them have simple splays.

28. Symmetry is discussed in the text after XII:17, and before XIV:20. See also XIII:20.

PHOTO 547: The great volume of the nave, over 100 metres in length, and except for the choir enclosure and júbe *looking today almost as it did seven centuries ago.*

activities in most things. Among the most important personal and unfettered decisions made, just taking those of the first thirty years, were the alterations to

- axes, centres and proportions of the plan (during campaigns A-F)[29]
- internal sanctuary piers (E-F)
- porches in plan and in detail (E-V)
- aisle sills, walkways and windows (F-H)
- sanctuary buttresses (B-I)
- chapel centres, buttresses and mullions (G-J)
- arches and heads over aisle windows (J-O)
- South exterior elevation and north over porches (L-V)
- Triforium passage shafts (M-Q)
- Triforium roofs, tower rooms, cross walls, buttresses etc (M-W)
- interior transept galleries and balustrades (P-W)
- colonnetted buttresses and plain (R-T)
- Clerestory piers west and east (R-V)
- ostiums and aedicules (V-W)
- nave and choir flyers (V-Z)
- tower plans, doors and buttresses (Y-c)
- Height of main vaults, lancets and roses (V-X)
- vault or lantern over crossing (V-X)
- vaults over towers, arches, heads and rosettes (h-o)
- innumerable structural concepts, often in direct conflict with one another (A-z)

When faced with this formidable list, what can we do but admit that the control of the clergy was not always complete, and the influence of any first plan far from total.

Faced with this sort of confusion today the building industry would organise a series of conferences to 'unify' and to 'rationalise' the contractual process; but we should not assume that medieval people would think of doing this. We are in an age of management and technocratic control, and above all we look for orderly and easily administered solutions which require co-ordinated management. The results show in the ordered monotony of our office buildings and suburban blocks of land. Fortunately medieval man had little urge for this sort of thing. Only at the centre of political power did medieval builders approach our controlled and repetitive work in the giant military constructions which we can still see in Richard's Welsh castles and in the town walls of Carcassonne and Avilla.

Their confused contractural system might be repugnant to us, but to them it was the natural state of affairs. It worked for a number of reasons, not least of which was the image most men held of the cathedral as the City of God. It was the natural product of the Age of Faith, and must have directed and inspired their work at every level. Within that each master had his own individual vision of how to realise it. Depending on the master the height of the cathedral may have varied by two meters or so, the type of piers may have been different, and the flyers arranged in some other manner. There are many ways to work out the first plan of a cathedral and its dimensions. Some masters liked towers and others did not, some preferred a screen of colonnettes and other used plain surfaces or aedicules. Chartres has something of all of these solutions, but immanent in all of them lies an idealised vision of the cathedral which was as powerful in their minds as was the glass box in ours during the '50's and '60's. The mannerisms and techniques used were, in the final analysis, the tangible realisation of this image.

So, if the clergy were not interested in the technical aspects of their cathedral, and were satisfied as long as it looked well from the inside, what of sacred geometry? If the clergy had understood 'the great art' would they not have had as much to say about it as they had about symbolism and iconography? Though some clerics, including Thierry of Chartres, seem to have had some interest in geometric matters, the majority left it to the master mason. Suger does not once discuss it, nor does Peter de Roissy. And neither do the masters. There are no manuals on design and building, and there was no need as long as the ancient oral traditions were kept alive. It is indicative of the changes brought about during the Renaissance that the only surviving commentaries by medieval masters date from the last decades of the middle ages.[30]

A painter does not need geometry. His head tells his hand what to do and his eye immediately checks that it is right. But in building we cannot work like this, not unless a man is erecting his own house with his own hands, or a tribe is constructing a traditional shelter in a non-directed and communal way. When structured societies build large works a way must be found to retain information, and to replicate it in simple rules. The medium for this information is templets and drawings, but the method for extracting it from the imagination and for transforming it into a communicable form is geometry.

When making a drawing or a templet we use a ruler to mark the straight edges and a compass to draw the

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29. References to each of these items may be followed in the isometrics.

30. Bucher. The only text we have from this period is the much discussed notebook compiled by Villard de Honnecourt some time around 1235. It has been assumed that because he recorded building matters and techniques for setting out and scaffolding and so on, he was a master mason. I disagree with this because there is no sign in any of his drawings of geometry of those structural ratios which ensured that a building would stand up. On the contrary, because he had to record even the simplest techniques the book shows that he had received no education in building matters. An experienced man would have, in his own personal notebook, taken these things for granted. As Shelby says, instead of his notes forming "a textbook encompassing everything that a Gothic architect needed to learn, it is rather like bits and pieces of a ship that has otherwise disappeared into the sea of oral tradition on which it sailed" (1971(1)). His notes are only a smattering of knowledge without any of the geometric kernel which, as Harvey says "differentiated the architect from the mere mason or carpenter" (1972, p.93). Leonardo da Vinci's notebooks are, on architectural matters, much more convincing in content and in his manner of drawing, yet we know that though he made patterns for some facades which may have been followed, he was never more than an adviser to the builder. This professional role did not exist in the thirteenth century. You were either the master mason and therefore the architect as well, or you were outside the craft. This is why I think that Villard was a craftsman or a sculptor in stone

curves, and anyone playing or ‘doodling’ with tools like these will soon discover the whole panoply of geometric imagery. Secondly the structural knowledge which is passed on from master to apprentice relates sizes to spaces and heights by ratios, such as half the number of feet in a span expressed in inches plus one inch will give the depth of a hardwood joist. These rules of thumb are stated and are learnt as ratios, for as the span gets larger the joist will too. In practice this involves the designer in geometry as well as in calculation. This sort of geometry in architecture is like number in nature, for it allows us to repeat an arrangement from one place to another, and even where the conditions may vary we have an easy way of carrying our structural experience with us so we may use the successful ones again and again.

Even in a simple design, like the square plan of the pyramid, the master must use geometry to set it out on the ground. We know the Egyptians used the 3:4:5 triangle to establish their corners accurately, and Scarlet could not have set out his scheme at Chartres without the use of many such devices. Geometry was here the indispensable means for transforming the design on paper into reality.

Once geometry began to be used in ancient times as the hand-maiden of communication, it began to modify the way the designer thought of his building. If he had different rules-of-thumb for his structural walls and for the decorative string course he would inevitably find places where they were at variance with one another. In the triforum the footings under the cross-walls were a little lower than the arcade passage floor and its string, as each was derived differently. The fact that they could keep the ratios affecting different parts distinct encouraged them to design each one separately, and then to find points of coincidence. Once they were able to distinguish between functions and to maintain this distinction in a meaningful way through the building, geometry helped to keep each one separtaed in the master’s mind. Similarly when a part was set within a larger element the geometry of the part could be related to the larger to maintain a unity between them. In this geometry became the great unifier.

Not that medieval geometry was as we know it from school days. The interludes have already shown what their methods were like. There is hardly a hint of Euclid. Though his works were known in Chartres and “while the documents pay much lip service to Euclid as the founder of the craft, in fact Euclidian geometry as such was little used by medieval masons. This can be seen in the sketchbooks of Villard de Honnecourt, Martin Roriczer, Hans Schmuttermeyer, Lorenz Lechler and other anonymous late medieval master masons. These little books contain no axioms, no theorems or proofs from Euclid, nor any serious interest in mathematical reasoning. Instead, they allude to, or explicitly set forth, rules to follow, step-by-step, in the physical manipulation of geometrical forms - circles, squares, rectangles and triangles - in the recommended proceedures for designing and building Gothic structures.”[31]

The most compelling reason for the use of geometry, particularly in sacred structures, was nowhere mentioned by Euclid. It was to give the structure significance. The medieval mind was “preoccupied with the symbolic nature of the world of appearances. Everywhere the visible seemed to reflect the invisible.”[32] The world was therefore not real in itself, but was the image of the ultimate reality behind the senses. They sought this through those abstractions of geometry and number which were most clearly seen to express the nature of the infinite. As the medieval writer Erigena observed “we understand a piece of wood or a stone only when we perceive God in it.”[33] Consequently when man shapes this wood and stone with the most relevant proportions and harmonics he will perceive God in the wood and stones of the building. The more that God and His Grace are present in the design the closer will be the link between the sacred enclosure and their image of the City. This may explain why the architect, as both the recipient of so much grace and as the shaper of the stones, came to hold such a high position in the medieval community. We get the same message from Robert Grosseteste who was a young man when Chartres was being built. He wrote that without geometry it is impossible to understand nature, since the forms of all natural bodies are in essence geometrical, and can be reduced to lines, angles and regular figures.[34]

These many years spent on the cathedral have given me some sense of this. You can see in the interludes how there are few universally accepted rules, but that each master worked from his own private tradition. He was so certain of the ultimate truth of his own methods that he had no hesitation in changing those of earlier masters.[35] His certainty must have been great, in spite of the fact that he was constantly coming into contact with

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who was both literate and ambitious, and that perhaps when he decided to leave France to seek work elsewhere he began to improve his chances by collecting as much information as he could on how to be the master of the job so he could turn his hand to other work if it was offering. My later comments on the end of the building boom in the ’30’s which coincides with the date of this notebook may provide the reason for his wish to travel.

[31] Shelby, 1971(2), p.238. See Harvey, 1972.

[32] Simson, xviii.

[33] Expositiones super Ierarchiam caesestem I,i.

[34] Quoted by Simson, p.198.

[35] Though I think it is still too early to say much about the geometric thinking of the masters, I have noted some things. Not all the masters are as advanced, if that is the right word. Scarlet, and indeed most of them, worked to centres. Cobalt also worked to wall faces. When considering stress most of them related the direction of the stress to the plane of the wall as in GEOM:XII-E and XIII-C. In this way the form was reduced to an envelope of stresses in which the correct placement of the wall face prevented stones from slipping. Scarlet also worked to faces, but with a web of ‘energy’ as in his EN(cw) tower. Bronze worked on a dual geometry of centres and spaces which are simple and modular in GEOMS:III-A and B and to GM spaces as in GEOM:XI-A. But he did not work to faces. He was one of the first to see that all loads could been to pass through points, which led him to design the window-walls in the sanctuary and to guide his water along his axes. His design in

PHOTO 550: The expanding spaces moving out from the walls between the radiating flyers of the apse give the eastern end of the cathedral an added charge of energy. Such thinness and stability could only be achieved with the most careful planning and workmanship.

recognisably good work by his peers. He had every opportunity to modify his geometry in sympathy with his predecessors, yet he did not. Each man must have believed that only his methods would be the proper ones to use. It is as if there was no final arbiter or ultimate root from which the geometry sprang, but as if each master evolved his own from his private communion with the Almighty. The messages he received were kept private, and he assumed that those received by other masters were somewhat spurious. The masters seem to have had the same arrogance and certainty as the bishops and nobles they worked for. "The master mason believed that their special skill was the most notable on earth because it had the 'most part of this science of geometry'; and geometry in turn, being the Science used by God Himself to create the world, was 'the science that all reasonable men live by'."[36]

Along with this certainty goes an extraordinary obsession with accuracy. Scarlet examined Ruby's dimensions for the nave triforium, and took the trouble to modify them by only a few centimeters. For example Scarlet's bridges over the triforium passage are 7^{RF} wide, and this is only 80mm more than Ruby's. Why was 80mm so important? What was he really doing? Was he arbitrarily imposing his foot no matter what, or was he compelled to find reason and system in everything and could only accept those that complied with the methods he was taught? Could he not accept that Ruby was a competent master and would have worked it out well, and could therefore be trusted and his dimensions followed? Or was he concerned that if he did not alter them to suit his own methods then his own later work would not fit? and he would also have some difficulty in passing his instructions on to the quarry? I find this question a hard one to answer. Sometimes a later master will modify his predecessors' work to the nearest equivalent of his foot or its parts, but the usual thing was to impose his proportions over it, which is why particular ratios turn up again and again with the return of each crew.

This leads me to think that in small matters such as windows and cornices the master brought out his square with his favourite ratios marked on it, and by placing it over the previously laid stones he adjusted the shape of the next ones as his square directed. In large matters, such as the span of a buttress, he could not have used his

the big choir buttresses in GEOM:X-A shows this. He was aware of points and spaces rather than enclosures and masses, which is particularly apparent in his windows. Hollowness fascinated him. He decorated *into* his masses as in the north porch piers in GEOM:III-E and in the south tower GEOM:XIV-D. His use of Cφ suited his methods admirably for it can continue to grow sequentially, without having to refer to a common source as in the triforium wall footings in XIII:14, and in his elevations.

In a number of techniques they spoke a common language, as in the way Scarlet and Bronze determined their heights from the crypt floor, while Ruby and others worked their external heights from the levels of both the inside and the porch floors. Only Ruby (and sometimes Scarlet) seems to have worked to multiples of his foot, as the ones we have found in the sections are 2^2,5^2,7^2 and 8^2 plus 10^2 and a third and two thirds of a hundred feet. Ruby, Scarlet and Bronze all employed modules as in GEOM:XVIII-F, while Rose used the difficult pentagonal figure in GEOM:XVIII-E and XIX-C. Some masters designed to the wall face as in GEOM:XII-A, some to the rib shafts in GEOM:XIII-B, and some to the arch shafts GEOM:XII-A. Nearly all worked to the main axes on the lower levels, but above that their methods for calculating the H axes differed.

Bronze in his transept doors in GEOM:IV-B and Olive in his windows used clusters of numbers in their ratios like 3:4:5 and $\sqrt{2}:\sqrt{3}:\sqrt{5}$ and the Alchemist's figure in XVI:23 and 24. Cobalt's work was integrative in another way with an encompassing net of lines around his walls and piers as in GEOM:IX-C. His work was more aesthetic than intellectual, though he felt the forces rising in the building as well as descending, in square. The size of the work was too enormous. So he carefully measured across the building and either drew them onto a scaled-down plan, or laid it out full-size on a large space, so he could discover the pattern in it. Each time the master worked to the actual building as built, not to what he had expected to find, nor to what he had prepared for in an earlier campaign. Thus Bronze in fixing the height of the arcade capitals worked to the actual spaces, and not to the slightly smaller ones he had intended some years before.[37]

Accuracy in setting out is allied to accuracy in cutting and placement. The nave buttresses and the porches are built to a tolerance of 10mm, while the stones from which they are made are individually cut to an accuracy of less than a couple of millimeters either way. I find that the masters tried to be just as careful in their geometry. Bronze used a value of φ very close to 1.618 without ever staying as far away as 1.622! To set out incommensurable ratios as accurately as this he must have worked on a large flat surface. It is amazing, this accuracy, yet I cannot dispute the dimensions, nor the consistency with which he used this proportion in preference to all others. φ is one of Bronze's trade marks, just as the pentagon is Rose's. Scarlet never used it, and Ruby only rarely.

As they were so careful to be accurate we can see that it was more important for them to get their alignments right than to have a neat looking building. We can see this in the positioning of the piers in the transepts and in the sanctuary buttresses over both the aisle and the triforium walkways.[38] They did not take perspective into account, but only pure geometry as in the hexagons of the first bays around the crossing in VIII:49 and 50. As Levy remarked "the proportions are built into the work, not into the appearance. Their use is essential, not accidental."[39] However, once work was placed it could not be pulled out, and this must have posed some real conflicts in their minds. Somehow they had to reconcile the 'truth' of their geometry with the actuality around them. They could only impose their will over it in a limited way, which they must have found terribly frustrating.[40]

Another consequence of the individuality of their geometry is that we can not expect to find those simple geometric solutions so beloved of some scholars. It has been argued that the further back we go in time the greater clarity there would have been in these concepts. Fragmentation is the general process of all things with time, visible in a hundred and one signs in all human endeavour. However, it is patently clear that the simple -we might say simpleton - approach of these scholars is the result of the loss that was suffered in speculative knowledge since the fifteenth century. This loss 'progressed' to give us the standardised grids of modern architecture which impose a unity which is only related to physio-economic standards.

The necessities of Sacred Architecture are quite different. Sameness and uniformity is abhored, since they deny the Principle of manifestation. On the contrary in searching to express the Principle latent behind what is actually revealed we realise that the Truth is so all-encompassing that it may be glimpsed only in multiplicity. This is why there are at least three axes, half a dozen places to take the overall dimensions to and as many subsidiary lengths stemming from the primary ones as they could pack in.

And as in geometry, so in number. Meanings are more specific in number than in geometry. To some extent it is possible to say that $\sqrt{2}$, coming from the square, is the root of the material and should therefore be applied to structural elements in the building, and that as $\sqrt{3}$ is the root of the triangle it should relate to the more spiritual parts; and sometimes this is so. But on the whole the reasons for using one ratio rather than another are more obscure in geometry than in number. The Bishop of Auxerre who had been a student at Chartres just before the cathedral was rebuilt wrote that "number binds all things, rules the world, orders the globe, moving the stars, tying together the elements and marrying the soul to bodies, earth to heaven, the celestial to the transitory."[41]

Geometry was enriched by posing one set of elements against another. For example by combining the diagonal of the square with the simple 2:5 ratio used in some of the verticals, two sets of proportions could be overlapped compelling the master to find ways to reconcile them.[42] As Dufay was doing in polyphony, using one voice against another and setting one sequence of notes against another, the masters were doing in geometry. And like them Dufay's singers would 'meet' at various points where their voices would resonate with greater emphasis. It is highly significant in this comparison that these words by Levy-Strauss written about music apply with the same strength to the medieval view of number and geometry,[43]

GEOM:XII-H. While there is a lot of sense in the structural rules many of them used, their geometry is on the whole more artistic and sensitive than mathematical or logical. There is evidence for reasons behind the ratios, though of a more sympathetic nature than we would expect from our engineers. In the final analysis the only basis on which to judge the effectiveness of their geometry is performance: and on this they succeeded. Their work still stands.

[36] Harvey, 1972, p.139.

[37] This story can be followed in GEOM:XI-A, and for Ruby in the triforium and the clerestory in XII:25-31 and GEOM:XVIII-F.

[38] Discussed in GEOM:X-C and in XII:42/f.

[39] Levy, 1956, p.240.

[40] Both Scarlet and Cobalt redesigned windows begun by others by simply setting a templet he had used before over the shape, and directing that one side should continue the outline begun by his predecessor, and that the other should use his. Scarlet did this in NW.31 in XV:13 and Cobalt in NW.44 in XV:17. Did the masters therefore have a standard gadget which they used to help set out their windows? It may have been hinged and could have been placed over the wall and adjusted to the conditions there to give the correct outlines with the minimum effort.

[41] Alain de Lille "Anti-Claudian", Philadelphia, 1935.

[42] See GEOMS:XI-C, XX-A, XIX-A.

[43] Levy-Strauss "Mythologies", Paris, 1964, I, p. 26.

and to highlight the similarity between them I have replaced the word 'music' with the word 'geometry'. He writes "that geometry is a language by whose means messages are elaborated, that each message can be understood by the many but sent out only by the few, and that it alone among all the languages unites the contradictory character of being at once intelligible and untranslatable - these facts make the creator of geometry a being like the gods, and makes geometry itself the supreme mystery of human knowledge. All other branches of knowledge stumble into it; it holds the key to their progress." And this was indeed very close to the medieval view.

Geometry pervades the entire building, from the largest element to the smallest. Every minor item is generated from the major, so that each window reflects something of the buttress it sits in, every buttress involves the bay it supports, and every bay contains the whole. As with Scholasticism the masters analysed the work into its parts, considered each separately, and then integrated them into a totality. This aimed to approximate "by synthesis as well as by elimination, one perfect solution. In its imagery, the High Gothic cathedral sought to embody the whole of Christian knowledge, theological, moral, natural and historical, with everything in its place and that which no longer found its place, suppressed."[44] Yet the method of synthesis was not universally agreed on by everybody. It was the personal view of each master as he interpreted the inspiration of his faith. Each act combined what was needed with something personal. This why half of the reasons for attributing the work to these masters are geometric.

When a master arrived on the job he must have spent a great deal of time reassessing the way he would use his geometry, for his methods were seldom simply pragmatic adjustments to suit the older work. The various plans for the apse chapels show this. Particularly notice how Cobalt in 1203 continued all his buttresses and mullions within a network of lines which he successfully imposed over the earlier plan for heavy rectangular buttresses which was itself a revision of the first plan. Not only was Cobalt's scheme lighter, but he managed to contain all the chapels within a web of lines, and this in spite of the fact that he had not been to Chartres before, and had to 'learn the job' before he could begin to redesign it.[45] And he did so in such a way that not only do the chapels reflect their own structural dynamics, but also every part of the building impinging on them. You can see that part of his fascination with this geometry is that it forms its own pattern across the building. This is beyond purpose. It is a pleasure experienced for its own sake, and reflects the real magic we see in lines and circles.

In this respect geometry is its own experience, developing from an inner aesthetic logic. The process is best described by Aristotle's parable that the house is there that men may live in it, but it is also there because the builders have laid one stone upon another. The cathedral is for God, but man has built it. It expresses in geometry and in number His universe, yet man thought out the geometry and selected the numbers. The growth of these techniques is therefore both practical and lusorious. Like warp and woof, purpose and play are interwoven into the one fabric. We should not think that only function mattered, nor that the game of numbers was played for its own sake. It is the unity of the two that makes their work so exciting.

Though their ideas seem so personal they must have learnt from one another. These masters worked all over France. The ones who built Chartres also contracted as far away as Mont St. Michel, St. Quentin and Chalons-sur-Marne. The many ideas used at Chartres form a sort of compendium of the motifs and styles found throughout northern France. Chartres was not built by local men, with the possible exception of Green, but by the best masters to be found in the Paris Basin. The cathedral is not the product of the Beauce, but of France.

In the 50 buildings I have studied which contain work which is contemporary with that of Chartres, I have been unable to isolate more than twenty-five contractors. Thirteen of them are more important than their fellows, and turn up again and again, seven of them at Chartres. Their process of learning as they travelled may, however, turn out to be indistinguishable from the natural changes occurring within the crew. I do not think that change was constant, for the same mouldings and ways of handling details follow the masters from place to place, and remain unchanged for decades. But new ideas do creep in, as with Bronze's windows and Ruby's bases. They evolve slowly, but often seem to represent something deepseated in the master's mind which is gradually preparing to express itself.

To give an example of this I will take the coping used over the choir flyers which I have ascribed to Bronze.[46] There is a series of them which seem to follow a logical progression, the simplest and earliest of which is to be found in the north-west corner flyer in the Soissonaise church of Orbais. The ones at Chartres are a bit more appropriately detailed to channel the water, and where the coping meets the tower buttress there is a gutter to lead it to the side. I think this detail shows a greater awareness of what is happening to the water than the ones in the lower flyers in the church of St. Pierre nearby, where the coping just butts into the back of the buttress, and the water has to overflow to get away. However in the upper flyer at St. Pierre the coping not only throws the water clear of the buttress through a projecting gargoyle, but it also picks up all the water from the main roof. The detail at Gallardon is similar. In all of these buildings there is other evidence nearby to show that Bronze had been working there.

Here in these five copings we can see an orderly progression of ideas from the moulded coping at Orbais, through a growing understanding of the water-discharging nature of the moulding itself, to the important break-through in which Bronze saw that he could bring all the water flowing across the building into a few channels and guide it so that it was discharged beyond the walls. The roof, the copings over the flyers and the buttresses were by then visualised as a homogeneous system for dealing with the rain.

This master had a long-term fascination with ways of handling water. In some of his cornices he hollowed out the centre of each paving slab to lead the rain away from the joints between the stones and towards the edge, and later on he arranged the gutters around the choir triforium to pass through the middle of the buttresses, a detail which is repeated at St. Pierre. In all of these examples you can see Bronze's fascination not just with the problems of shedding water, but with its guidance. He does not block it off, nor swiftly sweep it from his surfaces onto whatever happens to be below, but he traps it and then leads it away from his structure towards safe disposal points. It was a not unnatural culmination of this attitude that should lead him to guide the roof water itself so that it fell beyond the line of the building. Perhaps we can see here the inventor of this device which was to have such an important place in later medieval buildings.

From the evolution of these copings I would order these five jobs like this: Orbais, St. Pierre lower coping, Chartres-c, Gallardon upper coping and lastly the St. Pierre upper coping. The only date we have is 1222 for the work at Chartres. This and more examples like it may help us to date these other monuments. As with so many innovations, new ideas seem to appear first in the smaller jobs. Yet many historians have considered that the workshops of the great cathedrals were the centres of innovation, and that ideas moved outwards from them. The opposite seems to be the real situation for, as we should expect today, the larger the job the more conservative the design. We should not expect to find untried ideas too rashly attempted in expensive prestigious cathedrals. On the contrary they seem to have been tried out in the smaller parish churches first, and if successful adapted to the greater monuments.

Near Braine there is a small damp mouldering church, Lhuys, which has a chapel on the south side with all the details found in the earlier part of Braine. It may be that whenever a large crew came to a district they would be asked to handle many of the smaller jobs nearby. It seems that Bonneval, Santeuil, Dordan perhaps, Gallardon and St. Pierre have all been worked on by the contractors of Chartres. About 1210 Bronze set out the upper part of the lantern at Braine, which has many points in common with the larger one at Laon. The differences between them could tell us a lot about the crews who worked on them both. Braine was probably finished first if the consecration was for a complete building, and Laon seems from my chronology to have been finished in the early '20's. Above the crossing arch the order of the campaigns at Braine is

- Bronze: Sage: Bronze: Sage: and Scarlet who built the vault.[47] Similarly at Laon the order is
- Scarlet: Bronze: Sage: Jade: Sage and Scarlet again.

With the exception of Jade who started only one corner of the upper stage of the lantern, the same three crews worked on both jobs. The differences between Laon and Braine are, in essence, the differences between these four masters in a similar situation. A close study of how they differ could reveal much about their styles and methods.

There are two labyrinths in France which commemorate the architects of the buildings they rest in. Both were laid in the last years of the thirteenth century sixty or more years after these two buildings were begun. The one in Amiens was designed by Regnault de Cormant and in it he names two of his predecessors. Historians have naturally assumed that the first, Robert de Luzarches, was also the first architect, but the inscription does not go so far. It reads:

Chil qui maistre yert de l'oeuvre
Maistre Robert estoit nommes
Et de Luzarches surnommes.

which is just "He who was master of the works was...". He does not say that Robert was the first master, nor that he began the works, but just that he was the master. When I studied the cathedral I found evidence for 26 separate campaigns from the ground to the top of the triforium, with the same innumerable changes as at Chartres. So neither Robert nor any other one person could have had control over the bottom two storeys.

Regnault's first inscription mentions the bishop and the king who were alive at the time the cathedral was begun in 1220. I think he mentioned them as a substitute for the many itinerant masters whose names had accumulated over the early years of the work. So should the inscription quoted above be taken to mean "the name of the first master to be permanently engaged by the Chapter was Robert" implying that up to then, as at Chartres, there was no full-time professional supervision?

The inscription names only three architects for the 68 years up to 1288, and it is hard to believe that so few men could have controlled a job like this for so long a time. It was one of the largest buildings being constructed in France, and the Chapter would have naturally chosen experienced and proven men for it. While it is true that they could have been appointed in their forties and each of them could have spent twenty-five years on the site, it would not be the situation today. The average working span of senior appointees, as with kings and popes, is a lot less than that. However, if Robert had been appointed towards the middle of the century each master would have been in charge for a more realistic period. Further at Luzarches the little church has a small chapel dating from the '50's with details very like some in the clerestory at

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44. Panofsky, 1957, p.44-5.

45. See GEOM:IX-C.

46. XIX:14.

[47] Sage is one of the Green group of crews as discussed in ch. V, with a flattened corbel like Olive's.

Amiens. If Robert had come from Luzarches in the 1250's, the other two masters mentioned in the labyrinth could have completed Robert's work, including the transepts and the laying of the labyrinth itself.

The wording on the labyrinth is not specific enough to show that either this interpretation or the traditional one is correct. The situation at Reims is somewhat similar, though I think that there we have been given the names of those masters who were responsible for the most significant parts. There is incontrovertible evidence for at least thirteen campaigns from the floor to the triforium, and considering the depth of the footings there could easily be another one or two in the foundations. As at Amiens there is nothing in the Reims labyrinth that would contradict this.[48]

One of the four, Jean d'Orbais, is shown with a compass designing the apse, and the inscription reads 'qu'il encommencea la coiffe de l'eglise'. He is the only master whose duration on the site is not mentioned. Jean le Loup is recorded as having worked for sixteen years, Gaucher de Reims who 'ouvra aux vossures et portaulx' for eight, and Bernard de Soisson for an enormous 35. A text of 1287 mentioned Bernard, and if this had been his last year on the site his first would have been 1252. Subtracting Jean's sixteen years and Gaucher's eight from that takes us back to 1228, at the earliest. This is seventeen years or more after the start of the work. This seventeen years is quite enough to encompass the thirteen-plus campaigns of the *ad hoc* period, and it was around this time that the boom seems to have burst. Jean's long term appointment may mark the moment when the old contractural system was being replaced by the new. As with Amiens, my conclusions are the same: there is nothing in either of these inscriptions to contradict the thesis described in this book.

It was fortunate that I chose colours and not names for the crews, for it turned out that they were more than the individuals who led them. The teams have a longevity, and their methods have a permanence which outlives the individual. They are more like institutions than builders, or more like the larger professional architectural offices of today which continue to trade under names of founders who have been dead for decades.

As the masters of the crews succeeded one another they seldom seem to modify its traditions. The new masters took over the geometric methods, the foot unit and the style of their predecessors, and though there is evidence that these things were occasionally changed, there is still a timeless quality in the work of the contractors which raises them from a group of men under their chosen master to an institution.[49]

The masters and their leading cutters seldom seem to have left the crew. We find the same personal style turning up on sculpture and foliage time after time with the same master, showing there is a permanence in the membership of the team as there is in the institution it forms. They are not, in the sense accepted by many scholars, individual masons under the loose supervision of more or less resident masters, but they are well organised teams under the feudatory rule of a strong-minded leader. Thus it may not have been possible to improve the craftmanship of a crew by hiring better men, or by attracting other master's gangs. This must be a more modern method, and may have become common

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48. François Salet, 1967, has also suggested that more than one architect is to be found in the early years at Reims. The quotations which follow come from this article.

49. We will need a lot more information about the crews before we can draw many valid conclusions about the changes in the masters. For example when I see the geometry of Ruby's windows changing as they did in 1227 I am tempted to look for another master leading the team (XX:2). The change is not great, but the mental approach is new. It could be an indication of a growing maturity, as in the evolution of Bronze's 1198 windows in GEOM:IV-G. Over the next ten years Bronze's awareness of the nature of the geometry he was using grew, for he came to see it as the framework around the window which located only the corners so the faces were accidental. Similarly we cannot look to changes in the foot unit to date changes in masters, for the foot seems to be constant; in Bronze's case from at least 1190 to 1400. However I think that the Bronze master may have been replaced around 1216, for he then began to use double treads (XIII:51 and XVIII:79), he modified the shape of the corbel slightly and the vertical geometry in the doors (XVII:16) and the shape used around his arches (XVII:27/c). There are other changes to the corbel after 1225 (XIV:27) which may also indicate something, though as the crew had a tendency over their time at Chartres to reduce the size of the corbel and verticalise it, the shape of the 'signature stone' may not be indicative.

Before being sure that the master had changed I would want to know more of his style and the motifs he used from many places. The consistency of the crew's work over decades suggests that the succession was arranged from within the crew, and that they did not bring in a new master from outside. There would have been some form of selection or seniority within the team.

One of the clearest indications of change is in the work of Scarlet around 1209: the use of eccentric diamonds in his buttresses (GEOMS: XIII-F and XVII-A) combined with a new approach to his windows, especially SW.55-64 both of which were done in the one campaign (GEOMS:VI-C & F). The old master may have died during that campaign and been buried at Chartres, the new master may have taken over before coming and continued to use the traditional geometry for the lower window before beginning to evolve his own style as he gained confidence in his job. There is also a change in Scarlet's cornice between 1200 and 1215 (VI:56 and XIII:45), though there is no change in his foot, nor in his love of weighty and square-edged members, nor in the way he built his springing (XVIII:6) nor in the gangs who did his carving for him. More information from other buildings may tell us when the radical changes occured in a crew's work which would allow us to pinpoint the change in its leadership. We may then be able to link a dated tomb to a crew: for example Adam's at Reims cathedral and Libergier's at St. Nicaise nearby. The latter's foot, from his square which was incised into his tomb-stone, is the Roman at 296mm. Was he one of the leaders of Scarlet's team?

50. Branner, 1965, p.24-9.

51. The Cambridge Economic History of Europe, Cambridge, 1963, iii, p.132.

52. *ibid*, p.533. See H. Kraus, 1979 on the role of Philippe-Auguste's conquests on the financing of churches.

53. I have charted the dates that work was being carried out on most of the extant monuments of northern France over the 500 years of the middle ages, and almost half date from 1100-1250 with a definite peak between 1190-1230. These years also saw the peak of early medieval litarature and the best sculpture - ch. XVI. It was the time when the French kings first began to seriously assert their rights

only after the masters settled down and became professional advisers as well as contractors. The work could at this time only be improved, or indeed its quality sustained, by the training the master gave his men in their early years, and thereafter by the standards he continued to demand. The work at Chartres shows that there was a perceptible decline in craftmanship throughout the work to the '30's, after which it improved again. The first stonework is exquisite, but in between there are innumerable signs of poor cutting and sloppy site supervision.

Branner noticed allied changes in other French buildings during the same decades. He saw the architect travelling more widely than before, and that consequently the regional quality of most earlier work tended to be lost in a more universal style. He wrote that "the fluidity of the 1220's lasted into the next decade", but that afterwards work again became regional in character, the "variety of the 1220's and '30's vanished, and provincialism held sway."[50] I am inclined to see the influence of the more creative personalities behind the styles of a region rather than some amorphous *spiritus loci,* and would therefore re-interpret Branner's observation in terms of the masters themselves. I would say that the masons moved about the countryside spreading their ideas during the Chartrain decades, and that afterwards they stopped moving and settled down. Hence the style that had been associated with one areas was no longer being spread about, but had homed in on one region.

Branner goes on to say that inventiveness and experiment, which in architecture is nearly "always a sign of confidence, began to dry up - perhaps firstly in the east where the economic vitality of the Champagne fairs may have been sapped by competition and debts. Reims itself began the retreat from innovation as early as 1225, and over the next decade the north-east in general gradually followed suit." The Cambridge Economic History asserts that "at the end of the twelfth century and during the first half of the thirteenth, the Champagne fairs were indeed the centre of the international commercial activity of the western world"[51] and were more important than any in Italy or Flanders. There is a great deal of evidence for increased economic activity in northern Europe after 1180, and this coincides with the biggest boom in religious building that Europe has ever seen. By the middle of the next century this activity had been greatly diminished, the nobility was chronically in debt, municipal revenues "barely sufficed even for normal purposes"[52] and a large proportion of independent husbandmen were being forced to sell out to become rentiers. Again the changes in the economy were reflected in building, this time with a marked decline in the work being done.

The connections between them are uncertain, as are the dates. But this much can be said: after a century of population growth the decades around the year 1200 saw a great increase in building activity, and that Chartres was almost entirely built during that time. Towards the end of the 1230's while the transepts were being completed the amount of money being spent both at Chartres and elsewhere dropped off, in step with a downturn in the countries economy.[53] No matter how imprecise our understanding of these events, we can say with certainty that a boom followed by a bust must have

PHOTO 555: Top of NE tower with heads by Bronze, seen through the spokes of the flyers.

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over the nobility and to reduce the influence of the English. It also came after a prolonged period of growth in population, economic wealth and produce which seems to have followed one of those periodic heat-waves which had begun to raise temperatures in Europe from the ninth century. It may not be fortuitous that the decline in the French economy coincided with a high population which was not to be surpassed until the nineteenth century, and with a long period of drought accompanied by colder winters. "This severe pattern reached its peak during the thirteenth and fourteenth centuries, when Europe was swept by record storms, blizzards and cold weather, far exceeding anything which has occurred since ... In the Alps, glaciers closed permanently passes which during the previous mild centuries had been routes of commerce". (H.C. Willett, *Journal of Meteorology,* 1949 p.49). Also G. Utterstrom in "Climatic Fluctuations and Population Problems in Early Modern History" in the *Scientific Economic History Review,* 1955, p.3-47 shows that there was a sharp increase in cold weather around 1260-70 which was the culmination of a steadily worsening situation, and that this was followed from 1270-1350 by deteriorating economic conditions. The affect on agriculture, the source of people's wealth, can be imagined.

seriously affected the contractors. Many if not most of their men would have had to be paid off, and the shortage of work would have tempted the masters to settle down to assure themselves of a secure income. The 'diffusion' of the Gothic style into Burgundy, Germany and elsewhere after 1230 may have been as much a consequence of lack of work at home driving the teams further afield, as it was a conscious choice of the client to use the new Gothic style.

The system of discontinuous contracting used in the building of Chartres may have grown naturally out of the circumstances. During the eleventh century there were few localities which could have supported large groups of masons for long periods, though I would expect that the larger quarries maintained permanent accommodation for the men who gathered there. Smaller local builders in stone with five or ten skilled men could have been kept constantly at work on farmhouses, chapels, fortifications or repairs, but the monster teams of fifty men or more plus assistants and labourers - which was the size of the team brought from Toulouse to build the eastern end of Compostella in 1077 - could only have found work on the biggest jobs where the funds were adequate. Over the years the very large jobs would have encouraged some crews to become larger, and then, because they were larger than their own locality could support, they were compelled to look further and further from their home base or quarry in search of work. Then as the boom developed their ties with their homes were weakened until they became the totally itinerant contractors of 1200. Working quickly and competently they seldom stayed in the one place for more than a year, and this spread their ideas and their inventiveness across a huge area.

The masters worked at their buildings as if they were going to be employed there forever, and not as their experience told them for a few months or, at the most, years. For example at Lagny the western bays were built after the eastern ones in which there was no internal arcading and no walkway around the aisle windows. Yet in the westernmost bay Bronze began an arcade and a door out of the stairs for a walkway. He knew that both would have stood isolated until some time in the future when the old westwork was demolished. The economic bust put an end to that dream, and the westwork is still there today. At Gallardon near Chartres the windows of the choir were continued in behind the older tower in anticipation of being extended to the west. The tower and the Romanesque nave would have had to be demolished for this to happen, yet the masters confidently assumed it would be done, and prepared for it. Even in work which had only recently been completed we find the same restless search for bigness. The master of the nave at Soisson was planning no more than 40 years after the charming south transept had been completed to remove at least the upper storey so it could be raised to the same height as the new work.

It was the same with towers. None of them were capped off during the boom unless they had reached the topmost peak of their spires. In the lantern tower at Laon the staircase continues up another ten risers above the roof as if expecting to leap into the next storey before even the one below was finished, feverishly piling even more levels of precarious masonry over the already soaring stones below. Everything was in anticipation of the next move. To stop was unthinkable. One wonders where it would have ended if the boom in building had not petered out.

I have described in a lot of detail the building of a French cathedral around the time of Philippe Auguste. It is a controversial view, and is not true for all the medieval buildings in Europe, nor is it true for the whole of the period. But we can say that it certainly applies to the region around Paris for two centuries, perhaps for three. It is true for some contemporary buildings in England and Germany, but not for others. It seems to be true for more buildings before 1300 than it is afterwards. Obviously there were circumstances which produced this form of contracting, and there must have been others which discouraged it and led the industry to universally accept the permanent and specialised roles we act out today. We cannot say that just because it is not the way we have been used to seeing things done since the Renaissance it was a less viable way of producing great works of art. We can only say that it was different.

These great buildings were produced in a rapid and organic way. Not being master planned they were really more of a process than a project. The building reads as a continuum of ever-changing conditions and methods. As in any natural growing thing the final structure is not predetermined in all of its particulars, but only in its basic genetic form. The cathedral is an expression of history, and the culmination of a multitude of events each of which has left its mark. The construction of Chartres is the story of an organic evolution in stone which aimed towards the commonly held image of the Heavenly City, and which impressed this vision on all the men who worked on it. It reflects all the fascinating individuality of the men who led and worked in the great contracting teams, and the depth of the faith. As a result Chartres became, in the words of Bob Branner, "the most magnificent example of balance and unity that the Gothic was to produce."[54]

Mandorla Valley
Dooralong
Australia
8 November 1976
final text
25 March 1980.

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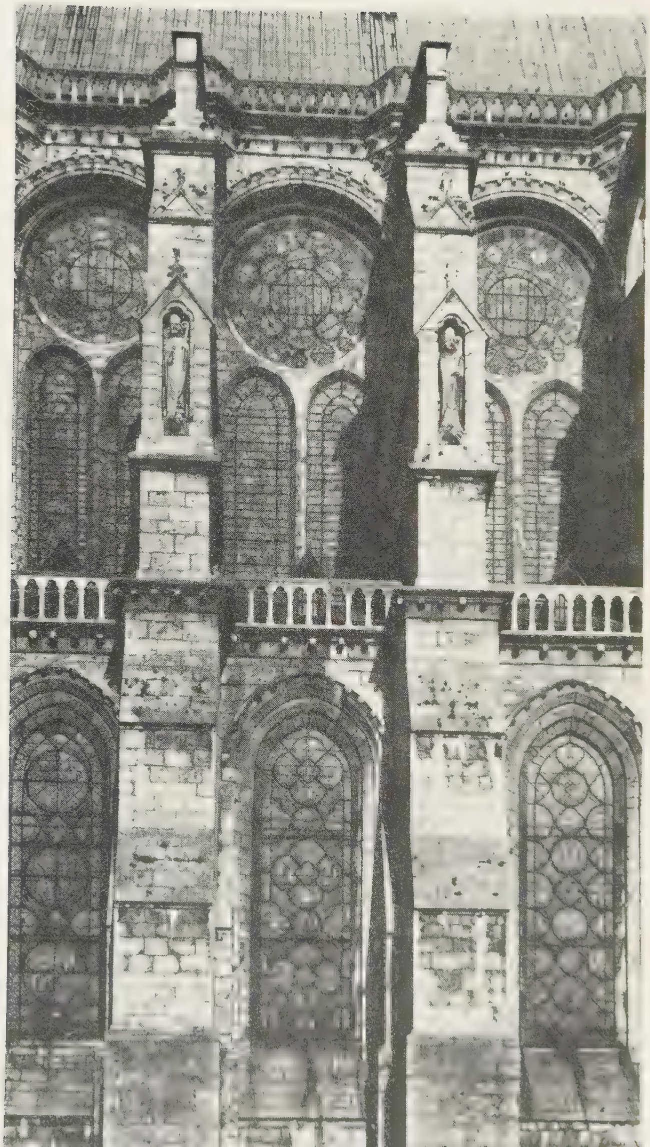
[54] Branner, 1969, p.83.



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Spring 45^{39}, 213^{51}, 235^{34}, 380, 455^{53}, 474^{10}.
Squid 230^{19}, 370, 507^{37}.
Swan 228$^{14\ 15}$, 230^{19}, 234-5^{34}, 353^{24}, 474^{10}.
Tips 213^{51}, 230^{19}, 234-5^{34}, 371, 393, 455^{53}, 456^{57}.

COBALT

Balls 256^{32}.
Bumps 210^{48}, 230^{19}, 235^{34}, 236, 460^{63}.
Clover 228^{14}, 353^{24}, 370-1, 390, 395^{38}, 396, 402^{8}, 411^{27}.
Cross 230^{19}, 395^{38}.
Dredge 213^{51}, 228^{14}, 230^{19}, 235^{34}, 256^{32}, 370-1, 390, 460^{63}.
Gobble 216^{56}, 230^{19}, 353^{24}, 383.
Helmet 210^{48}, 213^{51}, 216^{56}, 230^{19}, 234$^{32\ 34}$, 256^{32}, 371, 380, 383, 396, 460^{63}.
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Noblik 256^{32}, 323^{47}, 455^{53}.
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JADE
Goat 256^{32}.

OLIVE
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Crease 460^{63}.
Knife 256^{32}.
Lapwing 256^{32}, 460 + ^{63}, 474^{10}, 481^{18}.
Mantis 256^{32}.
Simplex 256^{32}.
Spirex 256^{32}, 461^{63}, 474^{10}, 481^{18}.
Spout 256^{32}, 411^{27}, 455^{53}.
Squelch 243^{6}, 256^{32}, 352^{24}, 460 + ^{63}, 481^{18}, 507^{37}, 509^{39}.

ROSE

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Cotton 216^{56}, 230^{19}, 370, 384, 385, 455^{53}.
Cup 216^{56}, 228^{14}, 342^{29}, 353^{24}, 384, 395^{38}, 407^{14}, 411^{27}, 474^{10}, 481^{18}, 500^{26}.
Curley 500, 505^{22}.
Dollop 455^{53}.
Flatlap 230^{19}.
Goose 216^{56}, 230^{19}, 384, 455^{53}, 474^{10}, 502^{28}.
Knit 230^{19}.
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Piker 455^{53}, 460^{63}.
Quercus 230^{19}, 371.
Scoop 230^{19}, 262^{38}, 502^{28}.
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RUBY

Braid 213[51], 230[19], 353[24], 370, 374, 382, 389, 490[2].
Circus 256[32], 455[53], 474, 507[37].
Crepe 230[19], 507[37].
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Hats 256[32], 464[71], 499[20], 507[37].
Hide 213[51], 226, 230[19], 235[34], 256[32], 361, 382, 474[10].
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Locks 172[20], 230[19], 235[34], 352[24], 361, 455[53].
Pawn 230[19], 323[42], 353[24], 455[53], 456[57], 464[71], 507[37].
Plane 235[34], 371, 396, 455[53], 499[20], 507[37].
Plasticine 507[37].
Rocky 172[20], 195[6], 209[47], 213[51], 226, 228[14], 230[19], 235[34], 243[6], 256[3], 363, 382.

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Dash 256[32].
Flix 256[32], 455[53].
Hoe 256[32], 455[53], 456[57].
Peterloo 176[32], 455[53], 456[57].
Screw 124[34], 256[32], 455[53], 456[57], 499[20].
Shelly 455[53], 482, 498[520].
Spade 455[53].
Squid 124[34], 256[32], 309, 455[53].
Tool 256[32], 455[56].
Zulu 243[16], 256[32], 262[38], 377, 455[53], 456[57].

PHOTO: 572 The author outside the north aisle of the sanctuary in 1977.

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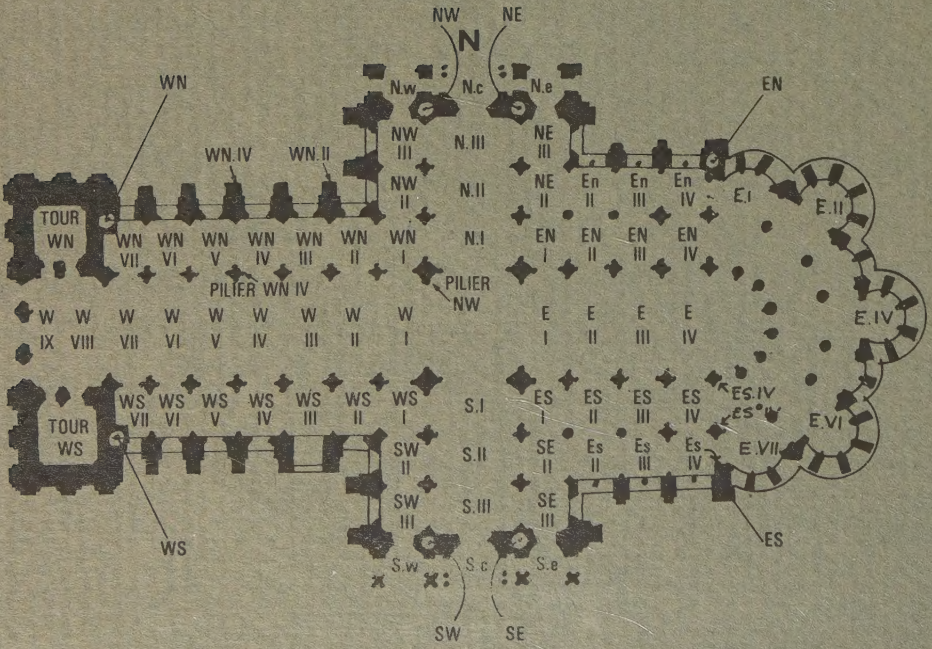
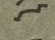
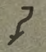
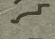


THE CONTRACTORS

	1194	Scarlet-A	The first plan
	1195	Bronze-B	Straightened axis
	1196	Rose-C	Reduced crossing
	1197	Olive-D	First porch sculpture?
	1198	Bronze-E	Began doorways
	1199	Ruby-F	Sills to nave
	1200	Scarlet-G	South porch
	1201	Bronze-H	Sanctuary windows
	1202	Ruby-I	Arcade arches
	1203	Cobalt-J	Nave aisle vaults
	1204	Rose-K	South porch lintels
	1205	Bronze-L	
	1206	Ruby-M	Nave triforium
	1207	Cobalt-N	Apse aisle vaults
	1208	Bronze-O	Choir triforium
	1209	Scarlet-P	Southern tower rooms
	1210	Olive-Q	Masons marks
	1211	Ruby-R	Clerestory in nave
	1212	Cobalt-S	Nave buttresses
	1213	Red-T	Corbels under treads
	1214	Rose-U	Nave springing capitals
	1215	Scarlet-V	Choir clerestory, nave flyers
	1216	Ruby-W	Choir flyers
	1217	Bronze-X	Height of vaults
	1218	Scarlet-Y	EN tower plan (cw)
	1219	Cobalt-Z	ES plan, choir flyer spokes
	1220	Ruby-a	North porch complete
	1221	Jade-b	SE tower plan
	1222	Bronze-c	Nave roof, third flyers
	1223	Olive-d	Vaults to nave completed
	1224	Rose-e	Crossing vault, choir roof
	1225	Bronze-f	Completed choir vaults
	1226	Jade-g	

	1227	Ruby-h	First transept vaults
	1228	Green-i	
	1229	Rose-j	South rose
	1230	Bronze-k	
	1231-2	Green-l	Apsidal towers vaulted
	1233	Ruby-m	North rose
	1234	Olive-n	
	1235-6	Green-o	South transept vaults
	1237	Anon-p	South towers vaulted
	1238	Bronze-q	
	1239	Query-r	North towers roofed
	1240	Olive-s	
	1241	Green-t	North transept vaults
	1242	Bronze-u	
	1245	Damson-v	
	1248	Lemon-w	West gable begun
	1250	Sapphire-x	Sacristy hall begun
	1254	Testikleys-y	
	1258	Damson-z	

The decision to omit transept towers.

	1264	Moccha-α	
	1268	Cobalt-β	
	1272	Testikleys-γ	WN tower almost complete
	1276	Sapphire-δ	Transept gables completed
	1280	Testikleys-ε	Sacristy completed
	1316	Sapphire-η	Chapter house begun
	1323	Moccha-θ	
	1335	Cobalt-ι	
	1340	Damson-κ	
	1345	Lime-λ	
	1350	Cobalt-μ	
	1352	Moccha-ν	Chapel St. Piat completed.